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The Electrical Exhibit at the World's Fair.

WE continue in this issue our series of large pictures illustrative of special exhibits in the Electrical Department of the World's Fair. The subject this week is the pavilion and tower which will form the central figure in the Electricity Building. While this is on the site assigned to the Phœnix Glass Company, the Edison Lamp Works, that important department of the General Electric Company, has rendered every assistance possible to make this display a fitting centre for this magnificent exhibit. Probably never before has such a dazzling spectacle been presented to the public as will be embodied in this great combination of glass and light. Not only will the display be brilliant in whiteness, but it will be gorgeous in color, as the various rainbow tints are combined and blended and ring their kaleidescopic changes. Here will be found a worthy rival of the electric fountains without—petrified, we may say, in pellucid crystal—typical, as has been suggested, of Astarte's tears, which, in another form, in Thales' hands, first gave to the world our amber soul and our electricity.

The Grave of Benjamin Franklin.

IT is a curious commentary upon the civilization of the present age that many of those who have honored their country in the world of science, and whom their posterity delights to honor in literature, are allowed to lie in unmarked graves, or in such that by their decay only emphasize the neglect of those who have been the beneficiaries of their lifework. A case in point is brought to our notice by a communication in another column, where the neglected condition of Franklin's grave is adverted to and the suggestion made that a small sum be raised by subscription from among the electricians of the country sufficient to replace the old fence and mutilated tablet by others more in keeping with the sentiment toward America's greatest philosopher, which actuates every true electrician's breast. The amount called for seems ridiculously small, and should be raised many times over as soon as the want is made known. We commend this plea to the consideration of the fraternity, and feel assured that the appeal of Mr. G. Wilfred Pearce will not have been in vain.

Glow Illumination.

THIS term has been applied to a form of illumination of which the glow-worm or firefly is a familiar exemplar. The term "glow-lamp" is appropriately applied to one or more of the forms of lamps which Mr. Tesla has exhibited at his lectures both here and abroad, but which has been misapplied to the incandescent lamp in which a highly heated filament is the source of light. As properly used it means a lamp, in the broad sense of the term, which is itself luminous, and, in its best sense, one which is luminous without heat. That glow illumination is possible is theoretically true, and almost every number of THE ELECTRICAL WORLD bears witness in its Digest of Current Technical Electrical Literature of how happily near we are reaching to this most delectable consummation. Many minds are busily engaged on the solution of this problem, and each new step is watched for with the keenest interest. No matter how trivial the step may seem, it may be pregnant of the greatest results, and the feeling is now undisguised that the time is not far distant when the filament lamp as a source of light will be relegated to the past and obsolete, and the glow-worm in mechanical simile will take the place of the less efficient carbon.

Electrical Fire Risks.

A PAPER on "Electrical Stations as Insurance Risks" was recently read by Mr. George P. Low before the Fire Underwriters' Association of the Pacific Coast; and the authoritative statistics and facts presented in it should go far toward silencing the charges of extra hazard often made against electric light stations. In the early days of electric lighting the makeshift character of such installations undoubtedly gave reason to the prejudice that soon became widespread and that still lingers so tenaciously in the minds of insurance ratemakers. This condition, however, has been completely changed, until to-day there is probably no class of buildings in which the risk is less than in a modern electric light station. The efforts, however, in this direction have not been met as they should be by the insurance interests, and the dissatisfaction noted by Mr. Low has a substantial foundation. The favorable tone in which Mr. Low comments on the claims of the insured is frequently found in the expressions of underwriters' experts, and there is little doubt but that if insurance authorities desired to obtain and utilize the opinions of these gentlemen on the subject, the relations between insurers and insured would become more amicable. To continue to class central stations as hazardous risks in the face of the present condition of affairs leads to the suspicion that the insurance companies rely upon popular prejudice and ignorance on the subject to sustain them in a course that is manifestly unjust, besides being a short sighted policy in the final effect on their own interests.

The Feeder and Main Patent.

THIS seems to be an epoch of important decisions by the courts relating to electrical patents, such as has not been equaled in point of number for the same period of time in the history of the electrical industry. We chronicle this week still another decision which has excited the greatest interest in electrical circles. It is one which was handed down on March 28 by Judge Green, of the United States Circuit Court for the District of New Jersey, in what has become known as the Edison feeder patent case. In regard to the text of the decision nothing is as yet known, the court having merely announced that it had ruled in favor of the Edison Electric Light Company as against Westinghouse, Church, Kerr & Company, the defendants. In the absence of the text it is impossible to comment upon the breadth of this decision. But it may be stated that the patent in question relates to the method of equalizing the tension or pressure of the current through an entire system of electric lighting, or other translation of electric force, preventing what is ordinarily known as "drop" in those portions of the system the more remote from the central station. It is but natural that the successful parties to the suit should claim the decision as far reaching, and that the defendants should restrict its application as much as possible, and such is the case. When it is understood, however, that the General Electric Company claims that this patent gives them absolute control of all present methods of distributing the electric current to large areas for light and power purposes by the constant potential system, it will be seen how vastly important this decision may prove.

The Interdependence of United States and Foreign Patents.

THE decision of the U. S. Supreme Court in the case of Huber vs. Nelson Manufacturing Company, referred to in our last issue, declaring invalid the Edison carbon transmitter patents by reason of their having been issued after the issue of similar patents in England, and subsequent to the lapsing of such prior patents by reason of non-payment of taxes, called up, in a way more forcible than has been done since the Bate Refrigerator Company vs. Hammond case, the question of how far are American patents affected by the expiration of similar patents previously granted in foreign countries, and is likely to give rise to considerable discussion. It does not seem to be clear in the minds of the public what constitutes in the eyes of the law a lapse of a patent whose life may be extended from time to time by the payment of certain prescribed taxes, or which may be forfeited by what is technically termed non-working. The importance of this question is still further emphasized at this time by the claim of the American Bell Telephone Company in its thirteenth annual report, just received and published elsewhere in this issue. In view of the interest attaching to this point, THE ELECTRICAL WORLD gives space to a somewhat lengthy interview with Mr. Park Benjamin, who is certainly qualified to speak as authoritatively on patent law as any one. It will be a surprise to many to find that, although there has been much doubt in the public mind on this subject, the Supreme Court has spoken in no uncertain terms in the matter, and in this interview will be found the words of the court in the case of the Bate Refrigerator Company vs. Hammond.

The Annual Meeting of the American Bell Telephone Company.

IN another column is given a somewhat full abstract of the report made at the annual meeting of the stockholders of the American Bell Telephone Company, which cannot fail to be gratifying to them if true in all particulars. In this report it was stated that "the Edison application for a patent for the carbon telephone has also finally met with success, and resulted in patent No. 474,231 being granted to the Western Union Telegraph Company as assignee of Edison May 3, 1892; the carbon telephone patent will be controlled by the American Bell under its agreement with the Western Union." It is added, however, "that Edison's foreign patent for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patents. The company is advised, however, by counsel that the law is unsettled whether in such cases the application should be defeated by the expiration of foreign patents, but that the *better* opinion is that the fate of the foreign patent is *immaterial*." This report was read on March 28; and this "*better*" opinion, though doubtless given at an earlier date, was made public at an unfortunate time, for the reason that the day before its publication Justice Blatchford, of the United States Supreme Court, in Huber vs. The Nelson Manufacturing Company, had handed down a decision which really destroys the United States Edison carbon transmitter patent. Even supposing that that this so called "*better*" opinion had been expressed before Justice Blatchford's decision, it would seem as though it had little ground to stand upon, for the broader question had already been settled in the Bate refrigerator case. In this the question arose whether a United States patent applied for after a foreign patent, and while that was yet in existence, expired with the expiration of that foreign patent, when that expiration was caused by non-payment of taxes, or failure to work. It was decided that the patent did so expire. In Huber vs. Nelson Manufacturing Company, decided on March 27 last, it was held that a U. S. patent applied for after a foreign patent and after the foreign patent had expired by reason of non-payment of taxes, or failure to work, which was the case of the U. S. Edison carbon transmitter patent, did expire with the expiration of that foreign patent, which having occurred before the application for the U. S. patent rendered the latter inoperative from the start. It will, therefore, be seen that the latter ruling logically follows the former, or rather that the latter case is in reality entirely covered by the former, and there is therefore little in this for congratulation among the stockholders of the American Bell Telephone Company.

The Edison Feeder and Main Patent Case.

Judge Green, of the United States Circuit Court for the District of New Jersey, sitting in Trenton, on Friday, March 28, handed down a decision in the case of the Edison Electric Light Company vs. Westinghouse, Church, Kerr & Co., sustaining the well known Edison feeder patent, and deciding the issues involved in favor of the Edison Company, the complainants in the suit. This decision is the result of a protracted and important litigation and the outcome has been looked forward to with interest by all concerned in the electrical industry on account of the breadth of ground supposed to be covered by the patent at issue, No. 264,642, granted Sept. 19, 1882, which reads as follows:

What I claim is: 1. A consumption circuit in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding conductors not affecting the relative candle power of the lamps of the consumption circuit substantially, etc.

2. A consumption circuit in the main conductors of which is a definite small drop in tension not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption circuit, substantially, etc.

3. The combination of the consumption circuit in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamp connected therewith, with a feeding circuit having no translating devices and extending from the source of electrical energy to the centre of the consumption circuit, substantially, etc

4. A combination of two or more central stations having feeding conductors and consumption circuits supplied by such feeding conductors as described, of connections between the conductors of the central stations, substantially as and for the purposes set forth.

5. The combination in one system of a main circuit connected directly to a source of energy and containing translating devices and provided with resistances for lessening the tension of pressure of the current to that of the average of the system, a circuit not directly connected with the source of energy containing translating devices and a feeding circuit connecting the latter circuit with the source of energy, substantially, etc.

6. The combination of a number of uninsulated wires of different lengths, grouped together and fastened at intervals, forming a gradually tapering conductor, substantially as set forth.

The specification signed and witnessed this 4th day of August, 1880.

[Signed] Thomas A. Edison.

Witness: William Carman.
Otto A. Moses.

Just how broadly the judge has construed this patent does not appear, for the full text of his decision has not yet been handed down, the judge merely stating that he had found for the plaintiff and that he would submit his decision in full in the course of a few days. Of course its effect upon the electrical industry is at present merely a matter of conjecture, and its importance is estimated very differently by the two parties chiefly in interest, viz., the General Electric Company and the Westinghouse Electric and Mfg. Company. The interest, however, is not confined to these two parties, as the decision may affect the electric railway interests as well as those of electric lighting. The Westinghouse Company claims that the patent does not apply to the methods of distribution of current to electric railway systems, nor that it touches in any way the distribution by means of alternating currents, and that it will have no effect whatever upon their contract for lighting the World's Fair. It is also claimed by it that this patent expires in September of 1894 by reason of the expiration of an English patent dated September, 1880, awarded to Edison and running for 14 years. The General Electric Company, on the other hand, claims that it does not expire until 1899, and that it does apply to electric railway systems and other cognate applications of electricity, and cites, as showing the intent of the patent, the descriptive remarks accompanying the specifications, in which the inventor uses these words:

"This invention relates to a method of equalizing the tension or pressure of the current through an entire system of electric lighting, or *other translation* of electric force preventing what is ordinarily known as "drop" in those portions of the system the more remote from the central station, and also to other features in the systems for the utilization of electricity as hereinafter explained."

This it claims shows that the intention was to cover the method now so universally employed of distributing current by means of feeders to centres of distribution, under which head, it is claimed, comes the supply of current by means of feeders to the trolley wire as truly as it does the distribution to centres of electric lighting which is more specifically stated.

A call at the offices of both these companies led to no further information, as neither of them is willing to discuss the decision until the text is in hand. While the defendants have the right of appeal, each step in the course of a litigation, especially such as this, which may involve so generally the electrical interests, is considered of great importance. In the case of appeal, it would come before the United States Circuit Court of Appeals of the Third Circuit at Philadelphia, it comprising New Jersey, Delaware and Pennsylvania. Beyond the decision of this court there will be no appeal. The judges of last resort will therefore be Judges Acheson, Dallas and Butler. The fact that Judge Green has announced for the plaintiff in advance of making public his full decision is somewhat unusual, although not without precedent, for such has been the practice occasionally in the United States Supreme Court.

The Grave of Benjamin Franklin.

The following communication has been received from Mr. G. Wilfred Pearce, superintendent of the New Jersey Lamp and Bronze Works, New Brunswick, N. J.:

To the Editor of the Electrical World:

Sir: The remains of Benjamin Franklin and his wife are interred in a sadly neglected graveyard in Arch street, Philadelphia. It is surrounded by a high brick wall, save at the grave of the Franklins, where an ugly and tawdry iron fence enables passers-by to observe the defaced tombs, illegible epitaphs (composed by the great philosopher) and the broken stones, long without cement.

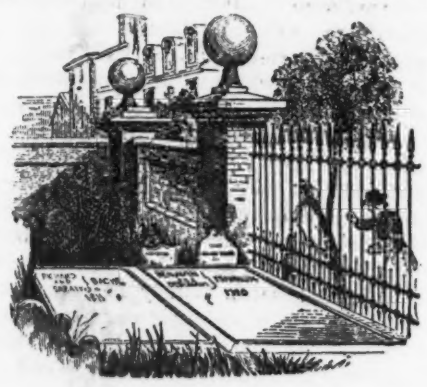
The whole aspect of the graves is a standing reproach to the citizens of a city to which Franklin bequeathed large sums of money. I suggest that the electricians of the country contribute sufficent funds to put the tombs in good order, and erect a new fence and memorial tablet of enduring bronze, which will stand for centuries as a tribute of respect to the memory of the father of electricity applied to practical purposes.

The estimated cost of repairing tomb and making fence and tablet is $1,000, and in order that all may contribute I would suggest that 10 cents be the sum from each subscriber. If there are others who care to give larger sums, an endowment fund will be created and the income devoted to keeping the tomb in repair for many years to come.

Contributions may be sent to me, or to Mr. W. H. Johnson, secretary Edison Electric Light Company, Philadelphia, Pa., who will disburse the money for the purposes for which it is required.

G. Wilfred Pearce.

The suggestion of Mr. Pearce is worthy of consideration, and any step toward the preservation of the Franklin grave or to the erection of a monument worthy to



The Grave of Franklin.

mark the spot where the remains of the great philosopher lie will undoubtedly receive the approval of those who are so greatly indebted to this pioneer in the electrical field. While Benjamin Franklin desired that his grave should be marked in the simplest manner, it is assuredly not a sign of respect to him that it should be neglected, and the slight marks already there be permitted to become effaced.

As stated in the above letter the little graveyard at Fifth and Arch streets, Philadelphia, is in a sadly neglected condition. The brick wall, nearly two centuries old, is fast crumbling away, and the iron fence which in 1858 was substituted for that portion of the wall near Franklin's grave is far from being ornamental.

The spot where Franklin is buried is in the corner of the yard, as may be seen from the accompanying illustration. The grave is covered by a slab which bears the simple inscription,

Benjamin and Deborah } Franklin, 1790.

Two small upright stones stand at the head of the grave, one to the memory of John Read, the father of Mrs. Franklin, and the other to "Francis F., son of Benjamin and Deborah Franklin, deceased Nov. 21, 1786, aged 4 years, 1 month and 4 days." At the south, next to the Franklin grave, is a similar stone inscribed to Richard and Sarah Bache, 1811, the daughter and son-in-law of Franklin. In excavating a portion of the yard some years ago, another tombstone was discovered bearing the name of Dennis Franklin, a child of Benjamin Franklin, who died at an early age.

It was the wish of Franklin, expressed in his will, that he be buried "with as little expense or ceremony as may be," by the side of his wife, and that "a marble stone, to be made by Chambers, six feet long, four feet wide, with only a small molding around the upper edge, and this inscription—

Benjamin and Deborah } Franklin, 178—

be placed over us both." It is apparent that he fully expected to die some time in the decade beginning with the year 1780, but his death, which occurred April 18, 1790, was a few months too late to fall within this limit.

Park Benjamin on the Telephone Patents.

Mr. Park Benjamin being asked his opinion on the status of the Blake Transmitter patent and the statements in regard thereto in the thirteenth annual report of the Bell Telephone Company, which is reprinted in another column and which has excited considerable interest, said:

"The United States Supreme Court, in the case of Bate Refrigerating Company vs. Hammond, 129 U. S., page 164, stated as follows:

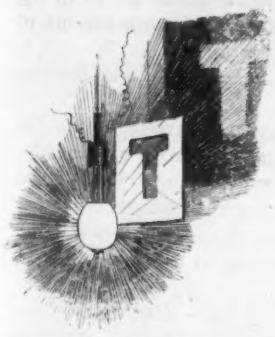
"Two propositions as to the construction of this section are contended for by the appellant: (1). That the words 'first patented or caused to be patented in a foreign country do not mean 'first patented or coused to be patented' before the issuing, or granting, or date, of the United States patent, but mean 'first patented or caused to be patented' before the date of application for the United States patent; (2) that the declaration of the section, that 'every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term,' does not mean that the patent so granted shall expire at the same time with the term to which the foreign patent was in fact limited at the time the United States patent was granted; but that it means that it shall expire when the foreign patent expires, without reference to the limitation of the term of such foreign patent in actual force at the time the United States patent was granted.

"We do not find it necessary to consider the first of these questions, because we are of opinion that the proper construction of § 4887, upon the second question, is, that the patent in the present case does not expire before Jan. 9, 1892, the time when the Canadian patent, No. 6938, will expire."

Therefore, the first question, like numerous other mooted questions of patent law, is not, at the present time, the subject of specific decision by the highest court. It has, however, been the subject of repeated decisions in the court below, more especially in the case of Gramme Electrical Company against Arnoux and Hochhausen Electrical Company, in which Judge Blatchford held that the meaning of Section 4887, Revised Statutes (Section 25 of the Act of 1870) "is that the United States patent shall expire at the same time with the foreign patent having the shortest term to run which was granted before the United States patent was granted, and not that it shall expire at the same time with the foreign patent having the shortest term to run which was granted before the time when the application for the United States patent was made." The Court then referred to the prior case of Bate Refrigerating Company vs. Gillett, 13 Fed. Rep., 553, in which Judge Nixon stated that he was "at a loss to understand what the time of filing the application has to do with the matter." At the present time, the law is as laid down by the circuit courts, and whether the United States Supreme Court will take any different view of the subject is, as the Bell Company asserts, a matter of opinion; but whether its view will be in accordance with the contention that the Bell Company expresses is simply surmise, which, of course, in the case of the Bell Company, is colored by what that corporation wishes to have happen.

I note that in discussing this question the Bell Company says that the "better opinion" is in favor of its own contention. On the preceding page it also states, with reference to another mooted question regarding foreign patents, "It is necessary to add, however, that Edison's foreign patents for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patent. Our counsel informs us that the law is unsettled whether in such cases the American application should be defeated by the expiration of the American patent, but that the better opinion is that the expiration of the foreign patent is immaterial." This means the opinion of the Bell counsel of course, which has long been suspected to be better than that of the United States Supreme Court. That it is actually "better" is now for the first time conclusively shown. In its decision in the case of Huber against the Nelson Manufacturing Company, as reported in The Electrical World of April 1, the Supreme Court decided "that a foreign patent, having lapsed by reason of non-payment of stamp duty, an American patent granted for the same invention is void," or in other words, that the lapse of the prior foreign patent by reason of non-payment of taxes destroys the American patent subsequently applied for. If the Bell counsel rendered that "better" opinion in advance of the decision of the Supreme Court, then prophetic powers stand in obvious need of repairs; if later, their next step will, of course, be to overrule that hasty and careless tribunal."

The New Hotel Waldorf.



THESE are days of restless activity, and nothing evinces the growing tendencies of the aesthetic side of our nature more clearly than the attention paid to the adornment of our public caravanseries and the comfort and ease of the public. As each new hotel in the metropolis is announced to be (and usually is) an improvement upon all that have gone before, the last is scarcely opened before another is announced that will eclipse it, and thus the public is kept on the qui vive by new "openings" which are intended to disclose the advances in the past year.

In no direction has decorative art made greater strides than in the adaptation of the electric light to the adornment of our dwellings, and it was to be expected that its highest development would be manifested in the palatial hotels which are springing up from day to day, each vying with the other to surpass in all that may make them attractive.

The subject of this sketch, the Hotel Waldorf, is the latest of these, and as the highest exponent of the development in this line may well attract our attention. Situated at the corner of Thirty-third street and Fifth avenue, New York, this beautiful structure, covering an area of 296 feet by 100 feet, rises 10 stories high, and finds its foundations beneath two stories underground.

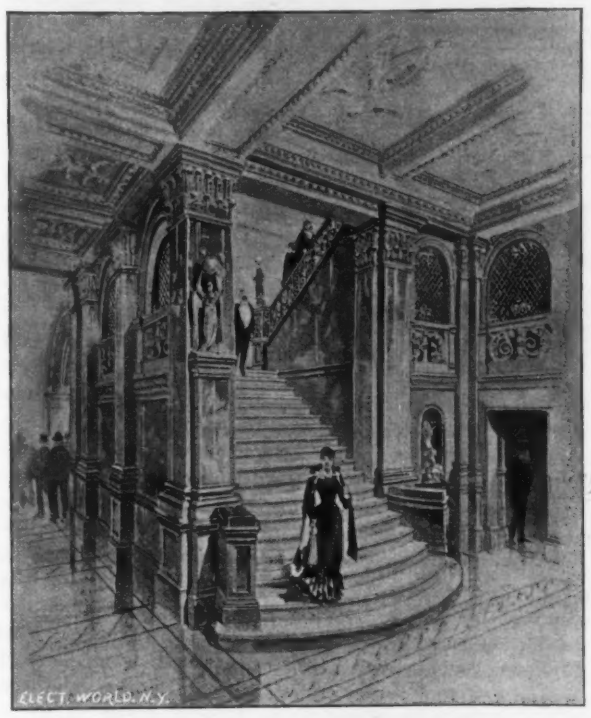
As the tree derives its life blood where the sun's rays do not touch, so the subtle current, whose throbs awaken into life the numerous glowlamps of this great pile, takes its origin in the depths below.

Away down below the street, through two flights of long stairs, one finds his way to the dynamo room, which occupies a generous portion of the subcellar. Here we find the great generators—eight in number—each of 50 k w. capacity, which supply current for light and power purposes throughout the building. These were supplied by the General Electric Company and are of the multipolar type, having six poles. The commutator is a departure from the more familiar type. While it is a departure from what we are most familiar with, still it is a reversion to one of the oldest plans ever adopted on dynamo-electric machines, viz., instead of being a separate cylinder of metallic segments, lesser in diameter than the armature, and separate from it, it is in this case the armature winding itself. As will be seen by the engraving, the pole pieces of the field are radial to the armature, The windings of the armature on their side presentation consist of squared copper bars, and these are themselves the commutator. Upon these press three pairs of brushes which are shifted as occasion requires by large tangent screws—all six being so attached as to be controlled by one screw. The engraving is a reproduction from a photograph made by one of The Electrical World's staff, and has an interest beyond its intrinsic merit from the fact that it was made entirely by means of the incandescent lamp, the exposure being four minutes. The arc light has been much used in photography, but in this case was unavailable. The view of the switchboard, which is also given, was also made by artificial light, but here the magnesium flash light and an instantaneous exposure produced the picture.

The generators are coupled two and two directly without intermediate gear, each to a straight line 150-h. p. engine making 200 revolutions per minute at 80 pounds of steam. The total capacity of the generators is 7,500 lamps, of which 6,200 are actually wired. Scarcely second in interest to the dynamos themselves is the magnificent switchboard, which was designed by Mr. John Van Vleck, chief electrician and consulting engineer of the Edison Illuminating Company, and erected under the direction of Mr. W. J. Donshea, the operating electrician of the same company. This is made of marble, and is divided into three panels which together occupy 12 feet of floor space. The central panel contains the Weston voltmeters, of which there are four, and the eight Weston ammeters; beneath these are the rheostats, eight in number, and below them the necessary switching apparatus for this portion of the board. This central panel is somewhat higher than the other two, extending about a foot above their upper edge. On either side, extending to a height of 7 feet 3 inches, are the switchboards proper.

The wiring of the building is in one sense duplex, in that a portion of it is for what is termed private lighting, that is, for the apartments and the less public portions of the house. The left hand switchboard is devoted to this, and the two-wire system is used throughout. The other division is called the public lighting division, and is supplied by the three-wire system, and controlled by the switches on the right-hand panel. While these two systems are separate and distinct, the switchboards are so arranged that they may be operated either separately or together on either the three-wire or two-wire system, the change being effected by a simple throw-over switch, designed by Mr. Van Vleck; these may be seen on both the right and left-hand panels near the base of the board, and directly adjoining the central panel. The public lighting, so-called, includes the corridors, dining room, reception rooms and those portions of the house more publicly used. By this separate arrangement of wiring it is possible to operate either system at any desired voltage, they being, when desired, as distinct and separate as though constituting separate plants.

The rheostats on the central panel are the General Electric Company's, and the switches are of the Bergmann make. The switchboard itself stands some four feet from the wall, and this space is partially, but not wholly, closed in at either end by a slab of marble extending ing to within about two feet of the wall; thus while rendering the rear portion of the board less public, still permits ready access to the cables and connections. All of the cables which carry the current for various uses throughout the building are brought through the Interior Conduit and Insulation Company's conduits to the rear of the board, those portions of the conduits exposed in the dynamo room being metal encased up to within a short distance of the switchboard. From this point to their point of connection with the board the cables are of the ordinary insulated type, but have been wound with asbestos twine, which, while preserving their flexibility unimpaired, has left them not less fireproof than the metal encased portions.



GRAND STAIRWAY, HOTEL WALDORF.

Ascending to the ground or office floor our attention is at once attracted to the Garden Court,a glass inclosed area almost directly opposite the main entrance from Thirty-third street. Entering the glass door, which separates this court from the main corridor, one is struck by the beauty of the arrangement. From directly opposite come the musical sounds of a plashing fountain, and on all sides the eye is greeted by exotic plants, ferns and trailing vines, which make the place a veritable bower. The dimensions of this court are 40 × 60 feet, and the ceiling is 20 feet 6 inches from the floor. A magnificent dome 32 feet in diameter and reaching at its highest point 40 feet from where one stands, pierces the ceiling in the centre, and suspended from the apex of this dome hangs one of the most magnificent chandeliers or, perhaps, we should say electroliers, that has ever been seen in New York City. This is 24 feet in vertical dimension and eight feet in its largest diameter. Its total weight is 2,000 pounds, but to the eye it seems much heavier, as it appears to be one mass of solid highly wrought gold. As will be seen from the accompanying illustration, it is highly artistic, and the sculptor has allowed himself free play in the use of the human figure and fantastic and conventional decorations. While apparently wholly of brass it may be said that the framework and those portions requiring great strength are of iron and steel, but these portions are hidden by copper, of which metal the other less bulky ornamentations are also composed.

One hundred and fifty lights will be supplied from this elegant fixture, which is the work of the Archer & Pancoast Manufacturing Company, 900 Broadway, New York.

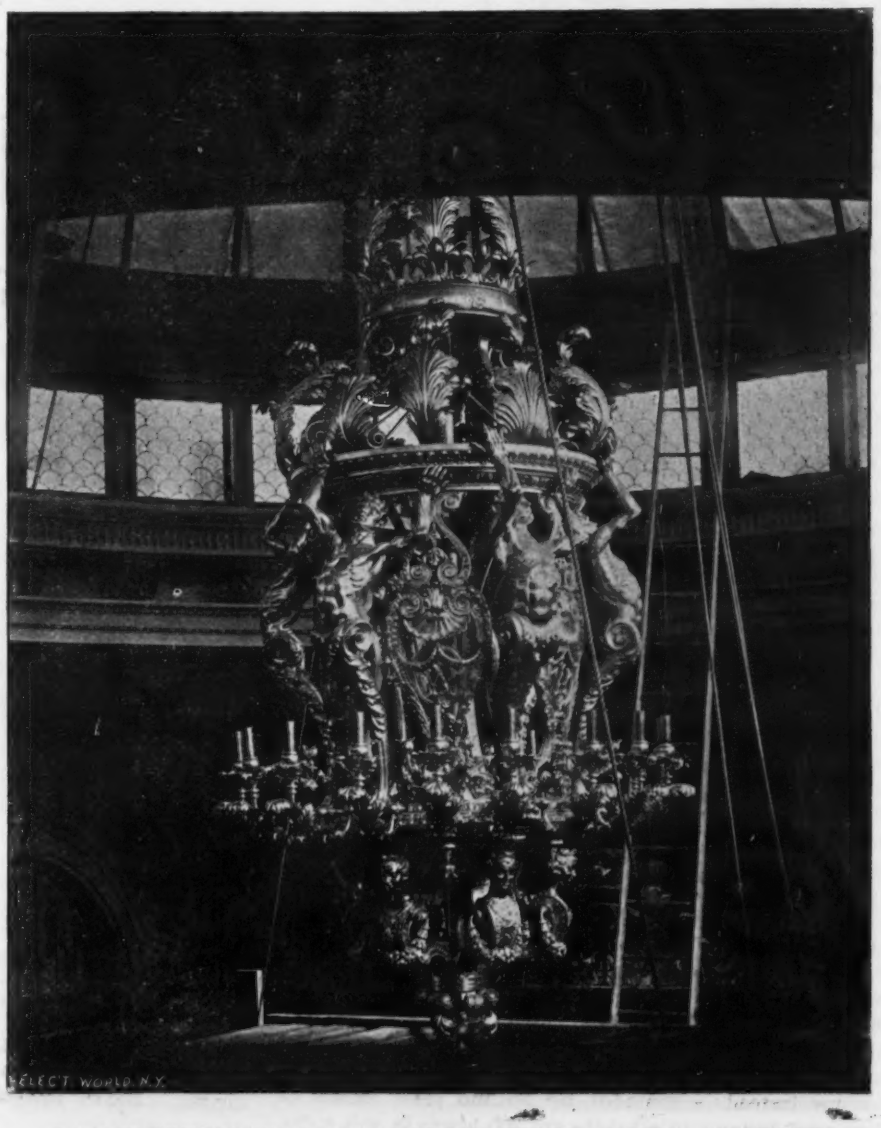
In the north wall of the court, which is the only one looking out upon the open, there are also two oval windows of beautiful design in opaline glass, which at all times during the daytime admit a softened light from without, which heightens the daylight effects when such are desired, but which is unobtrusive when illumination from without is obscured.

Directly to the northwest of the garden court and separated from it by a beautiful stained glass partition is the cafe. This is somewhat unique in its form of decoration, which is decidedly German in style. The wainscoting, which is high on the walls is of richly carved black walnut, and the ceiling, which is divided into panels, is ornamented with appropriate paintings on canvas. The artificial illumination is supplied from eight novel chandeliers taking the form of elk antlers, each terminating at its base in a decidedly Teutonic female figure extending in her hand the inevitable beer mug; each pair of antlers is entwined with an ornamental metal conduit, from which are supplied eight miniature incandescent lamps. The illumination thus given in the centre of the room is supplemented by that from 12 rustic brackets along the wall, each consisting of two lights. No bar is visible, but the refreshments are served to the 32 tables from an invisible source.

The main corridor is lighted by nine octagonal lanterns of worked glass, which are provided with 8, 10 and 12 lamps each.

The southwest corner of the ground floor is occupied by the ballroom. This is a beautifully decorated room and lights up most brilliantly, the prevailing colors being yellow and gold, interspersed with azure blue with here and there a touch of faintest green. In keeping with these are the electric fittings, which consist of two handsome chandeliers in gold, each with 18 miniature lights shaded by old gold paper cornucopias. Above these on each chandelier are six incandescent lights without shades. Around the walls are 12 gold brackets, each containing four miniature lamps hidden also by old gold accordeon-pleated silk shades. With the brilliant lights thus distributed reflected from the richly decorated walls and the handsome frescoes of the ceiling, this seems an ideal abode for Terpsichore.

To the right of the main entrance and to the south of the main corridor is situated an apartment in strong contrast to that just described; this is the Turkish room,

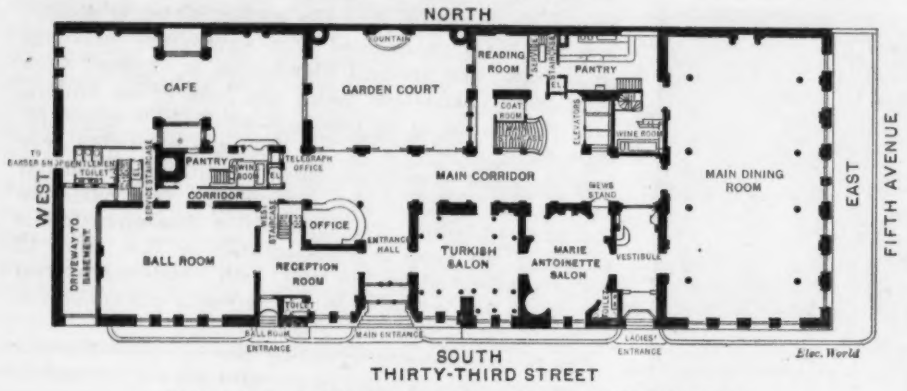


GILT ELECTROLIER IN THE GARDEN COURT, HOTEL WALDORF.

in which the fittings are entirely oriental, with their sombre greens, Turkish browns, mosaic floors of neutral tints, and rugs and upholstering of Moorish and Turkish design. Much of the furniture of this room is antique and many of the pieces have an individual history which adds to their value in the eyes of the connoisseur. The

electrical equipments are bronzes and glass with predominating greens, and consist of six chandeliers, each of unique and antique design—no two alike; in all there are 42 lights, all of which are shaded by shellwork, and other odd and fanciful designs of the glass worker.

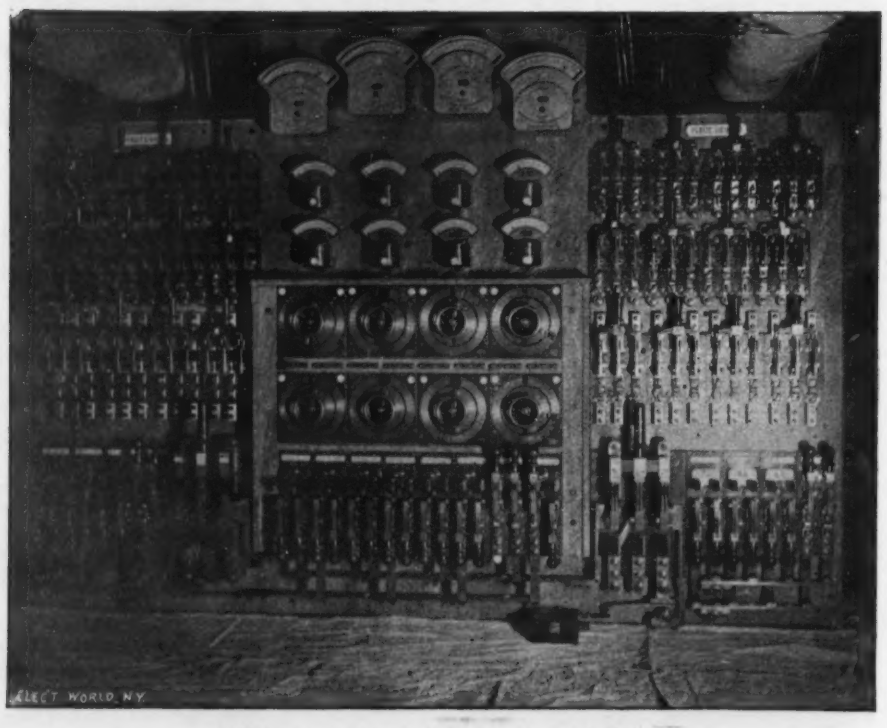
As if to add contrast to the subdued atmosphere of this apartment, the one to the east, and separated from it only by a curtained portal, is the ladies' parlor, termed the "Marie Antoinette" room. Here, as in the ball-room, brilliancy of effect is sought, and whites and bright colors predominate. Perhaps the first thing to strike the eye as one enters from the Turkish room is the magnificent painting by William H. Lowe on the centre of the ceiling, which is said to have cost $10,000. To the right as one enters is a bronze bust of Marie Antoinette, which is said by those who are supposed to know to be an excellent likeness of this celebrated but unfortunate



PLAN OF GROUND FLOOR, HOTEL WALDORF.

woman. The illumination is afforded by means of seven brackets in brilliant gold, each supporting 12 miniature lights in imitation of candles, and a chandelier whose rays are diffused in prismatic tints by cut-glass prisms in lieu of shades, and reflected again by the brilliant walls and the seven large mirrors with which the walls are adorned.

However esthetic we may be or removed our natures from the more material and baser elements of existence, still there wells up in our beings an uncontrollable leaning toward the gratification of our animal instincts, and however we may endeavor to suppress these tendencies the dining-room still has a tender spot in our hearts, and this we will visit next. Occupying the whole Fifth avenue front of the building and 50 feet on the Thirty-third street front, this grand hall occupies an area of 100 × 50 feet on the ground floor. But while the projectors had primarily in view in this portion of the building the catering to the inner man, they have not neglected the more esthetic side of his nature by any means. The ceiling is supported by eight massive columns in imitation of serpentine marble. At the north end is



SWITCH BOARD, HOTEL WALDORF.

a handsome mantel of the genuine stone, in the centre of which is an ornate bronze clock and on either side are bronze candelabra with imitation glass candles, each terminated by a miniature incandescent lamp, of which there are 24 in all. Around the walls are 30 groups of four each of similar candles, whose flames are incandescent carbon filaments, and through the centre are hung four chandeliers of similar design, but containing 32-c. p. lamps instead, surrounded by opaline glass globes of graceful design. In all there are 300 lamps in this room, all of which, except those in the chandeliers, are of 10 c. p. in pecan-shaped globes. These are connected either two or three in series across the outer wires of the three-wire system. Twenty-eight of these groups are supplied by three circuits and the remainder are supplied from two other circuits, each of which has its own separate switching arrangement.

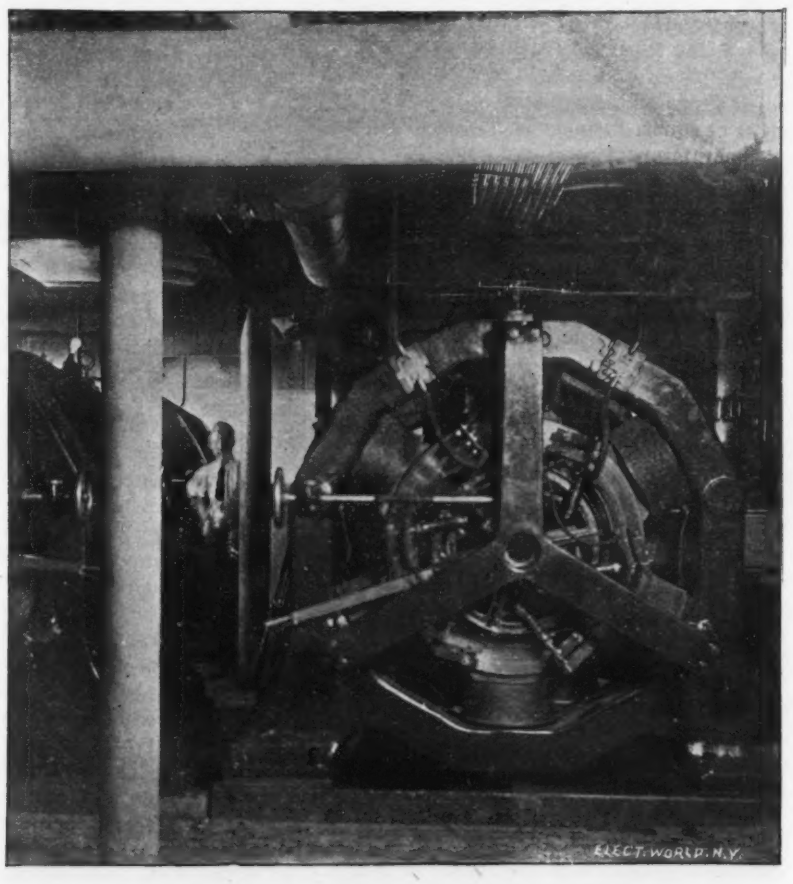
It would be impossible within the limits of our available space to take up each floor in detail as we have the office floor, but it will be sufficient to say that the whole of the building in equipment and decoration is in keeping with the elegance of that described. Further reference only need be made to what is called the state apartments on the second floor.

The state apartments consist of a suite of two bedrooms, three boudoirs and living rooms and a banquet hall. The latter will be of special interest to the lovers of ceramics, for its four walls are covered with cabinets filled with the choicest specimens of the ceramic art, some of which, too, are said to be heirlooms in the Astor family.

The banquet table of ample dimensions is illuminated from three chandeliers, each supplied with 12 pendant lamps surrounded with silk shades accordeon pleated. In addition to these the table itself is provided with a profusion of candlesticks holding genuine candles surrounded with shades to correspond with those above.

Each of the other rooms of this suite is in keeping with the elegance attaching to the name with which the suite has been dignified, and as our cicerone said, "if the King of England and the King of Dahomey were to meet the President of the United States by invitation of the latter, this is where they would probably be quartered."

Little more is to be said of the application of electricity in a modern hotel than can be said of this, but in glancing over those applications which are most pleasing to the eye, we are apt to neglect those more homely, though more useful ones, upon which so much of the comfort of the guest ultimately depends. In this establishment the electric motor has also found application. A printing press is part of the equipment, and this is operated by a 5 h. p. electric motor; the bottles are washed by machinery, and for this a 2 h. p. motor is employed, and the dishes, too, are washed by mechanical means, deriving power from a 5 h. p. motor, and the silverware is maintained at as high a polish as when it first came from the jewelers by buffers driven by a ten h. p. motor. These motors are all of the Crocker-Wheeler make, and to complete the equipment for the summer months, although cold air is on tap throughout the building, a number of electric fans are also on hand to set the air in motion and cool the fevered brow when the torrid rays of the dog days make existence within their reach intolerable, or at best undesirable.



MULTIPOLAR DYNAMOS, HOTEL WALDORF.

Theory of the Transformer.*—II.†

BY F. BEDELL AND A. C. CREHORE.

Thus far our attention has been confined to the magnetic circuit. Before investigating the action of one circuit upon another let us consider the energy of a circuit and the mutual energy of two circuits.

MUTUAL ENERGY OF ANY TWO CIRCUITS.

If the point P be in the vicinity of a circuit consisting of a single turn of wire, in which the current I is flowing, and a unit pole be brought from infinity to this point, the work done will be equal to the potential of the point; that is, $I\Omega$ [see equation (1)]. If a pole of strength m be thus brought from infinity, the work done will be $mI\Omega$, which, therefore expresses the mutual energy of the pole of strength m and the circuit with current I. Now, $m\Omega$ represents the number of lines of force emanating from the pole and threading the circuit, and so the mutual energy of the circuit and the field produced by the pole is $W = N I$, where N is the number of lines, due to the pole, passing through the circuit.

Now if this field is produced by a current flowing in another circuit, b, instead of being produced by the pole, and the lines threading the first circuit, a, due to this second circuit, b, are N_b, the mutual energy is, as before, the product of the current in the one circuit and the lines threading it, due to the other circuit, which in this case replaces the pole—that is $W = N_b I_a$.

Similarly, if N_a is the number of lines due to a, which pass through b, the mutual energy is $W = N_a I_b$. But it is evident that the energy is the same, whether we consider b in relation to a or a in relation to b; and, therefore, the mutual energy is $W = N_b I_a = N_a I_b$.

Now let M_a be the number of lines through b due to a unit current in a. The number of lines passing through b due to a current I_a in a is, then, $N_a = M_a I_a$. Similarly the number of lines passing through a due to a current I_b in b is $N_b = M_b I_b$. Substituting these values for N_a and N_b in the above expression for the mutual energy of the two circuits, we have,

$$W = M_b I_b I_a = M_a I_a I_b. \qquad (6)$$

Whence, $M_b = M_a = M$.

COEFFICENT OF MUTUAL INDUCTION.

M is called the coefficient of mutual induction of the two circuits and is defined as the number of lines which thread one circuit due to a unit current in the other circuit; or, it is the ratio between the number of lines threading one circuit and the current which produces them, flowing in the other circuit.

TOTAL ENERGY OF TWO SIMILAR SUPERIMPOSED CIRCUITS.

Let us suppose that the two circuits are identical in all respects, and are placed so as to coincide. The two currents, I_a and I_b, are equal and flow in the same direction. The energy stored up in the system may be considered as made up of four parts: First, the energy or work done in setting up the current I_a against the counter E. M. F. of its own field, or briefly the energy of I_a due to its own field; second, the energy of I_b due to its own field; third, the energy of I_a due to field of I_b; and, fourth, the energy of I_b due to field of I_a. Now from symmetry and the fact that the circuits are coincident and the currents equal, all of these four parts are equal The third and fourth, together, constitute the mutual energy of the two circuits, which, by equation (6), is equal to $M I_a I_b$. The first and second separately represent the energy of each circuit alone, and are together equal to the third and fourth, that is the mutual energy $M I_a I_b$. The total energy of the system is equal to the sum of the mutual and separate energies, and is, therefore, $W = M I_a I_b + M I_a I_b = 2M I_a I_b$.

ENERGY OF A SINGLE CIRCUIT.

Let us now consider that the two coincident circuits just discussed actually constitute one circuit, and that the current flowing in it is the sum of the two partial currents which we have been considering; that is, $I = I_a + I_b$. The coefficient of self induction L, of this single circuit, is the number of lines threading the circuit when unit current is flowing, and in this case is equal to M, the coefficient of mutual induction of the two component circuits. The energy of this single current is evidently the same as the total energy of the two component circuits, which we

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† For the previous section of this article see THE ELECTRICAL WORLD of March 25, page 223.

suppose coincide, and is, therefore, equal to $2\,M\,I_a\,I_b$. We may substitute $\frac{1}{2}\,I$ for I_a or I_b, and L for M, thus obtaining

$$\text{Energy of single circuit} = 2\,L\,\frac{I}{2}\,\frac{I}{2} = \tfrac{1}{4}\,L\,I^2. \qquad (7)$$

This expression for the energy of a circuit, which is here established from consideration of magnetic potential, may be proved from the laws of Joule and Faraday, and is so derived in a previous article * by the writers.

TOTAL ENERGY OF ANY TWO CIRCUITS.

The total energy of any two circuits, uninfluenced by other circuits or magnets, may now be directly obtained by adding their mutual energy, as given in equation (6), and the energy of each circuit separately, as given in (7); thus,

$$W = \tfrac{1}{2}\,L_a\,I_a^2 + \tfrac{1}{2}\,L_b\,I_b^2 + M\,I_a\,I_b. \qquad (8)$$

This may be obtained directly from the differential equation obtained by considering the increment in the energy of two circuits due to successive increment of the two currents. During the time dt the current i_a (small i representing a variable current) in the one circuit does an amount of work, $L_a\,i_a\,\frac{di_a}{dt}\,dt$, against its own counter electromotive force of self induction, and an amount of work $M\,i_a\,\frac{di_b}{dt}\,dt$ against the counter E. M. F. due to the current i_b in the second circuit; during this same time the current in the other circuit is doing the corresponding work $L_b\,i_b\,\frac{di_b}{dt}\,dt$ and $M\,i_b\,\frac{di_a}{dt}\,dt$.

The total increment in energy during the time dt is equal to the sum of these four parts

$$d\,W = L_a\,i_a\,\frac{di_a}{dt}\,dt + L_a\,i_b\,\frac{di_b}{dt}\,dt + M\,i_a\,\frac{di_b}{dt}\,dt + M\,i_b\,\frac{di_a}{dt}\,dt$$

If the two currents have increased from zero to the value I_a and I_b, respectively, integrating between these limits we obtain equation (8) as the total energy of the two circuits.

VALUES OF THE COEFFICIENTS OF SELF AND MUTUAL INDUCTION.

The values of the coefficients of mutual and self induction of two circuits can never be exactly obtained by computation; but in the case of two circuits placed side by side upon an iron magnetic circuit, the formulæ based upon the assumption of no leakage are approximately correct. Let us consider two circuits, which we will call the primary and the secondary circuits, and let S_1 and S_2, respectively, represent the number of turns or convolutions in each. The coefficient of mutual induction, M, is the number of lines inclosed by the secondary circuit when there is unit current in the primary. If there is no magnetic leakage—that is, if all the lines set up by the primary current pass through the secondary circuit—the value for M may be readily calculated from the law of the magnetic circuit. The magneto-motive force for unit primary current is $4\,\pi\,S_1$. The reluctance is $\Sigma\frac{l}{A\,\mu}$, where l, A and μ may have different values in each term of the summation, according to the particular part of the circuit to which each term refers. The total magnetic flux is equal to the M. M. F. divided by the reluctance, and in this case

$$N = \frac{4\,\pi\,S_1}{\Sigma\frac{l}{A\,\mu}}. \qquad (9)$$

Now, on the supposition of no magnetic leakage, every turn of the secondary includes these N lines and, in order to obtain the total number of lines included by the secondary, we must multiply N by the number of secondary turns. But the total number of lines included by the secondary due to the unit primary current gives the value of the coefficient of mutual induction, and so

$$M = \frac{4\,\pi\,S_1\,S_2}{\Sigma\frac{l}{A\,\mu}}. \qquad (10)$$

This is the general expression for the mutual induction of two circuits, irrespective of whether the magnetic circuit is continuous or not, provided there is no magnetic leakage. Of the several terms in the summation expressing the reluctance, some may refer to parts of the magnetic circuit through iron, and others to parts through air, and these terms cannot always be computed.

The value of the coefficient of self-induction for the primary is obtained in the same manner. The expressions for magneto-motive force and reluctance are the same as before. The magnetic flux N, obtained by dividing the one by the other, passes through each primary turn. Multiplying this flux by S_1, the number of primary turns, we get the total number of lines passing through the primary due to unit primary current. By definition this is the coefficient of self-induction of the primary, and so

$$L_1 = \frac{4\,\pi\,S_1^2}{\Sigma\frac{l}{A\,\mu}}. \qquad (11)$$

The coefficient of self induction of the secondary is similarly found to be

$$L_2 = \frac{4\,\pi\,S_2^2}{\Sigma\frac{l}{A\,\mu}}. \qquad (12)$$

The values for the coefficients of mutual and self induction given in equations (10), (11) and (12) always hold, irrespective of the uniformity or continuity of the magnetic circuit. The expression for the mutual induction (10) only holds true, however, when there is no magnetic leakage. In this case the reluctance $\Sigma\frac{l}{A\,\mu}$ has the same value in each of the above equations, and, therefore

$$M = \sqrt{L_1\,L_2} = \frac{S_2}{S_1}\,L_1 = \frac{S_1}{S_2}\,L_2, \qquad (13)$$

$$\text{and } \frac{L_1}{L_2} = \frac{S_1^2}{S_2^2}. \qquad (14)$$

The relation for mutual induction only holds true in case of no magnetic leakage. If there is magnetic leakage, and all the lines do not pass through the two circuits, the coefficient of mutual induction is diminished.

In the case of a closed iron magnetic circuit of uniform cross section, l, A and μ have but one value for all parts of the circuit, and there is therefore only one term in the summation. The formulæ then become

$$M = \frac{4\,\pi\,S_1\,S_2\,A\,\mu}{l}, \qquad (15)$$

$$L_1 = \frac{4\,\pi\,S_1^2\,A\,\mu}{l}. \qquad (16)$$

$$L_2 = \frac{4\,\pi\,S_2^2\,A\,\mu}{l}. \qquad (17)$$

These are the expressions for the coefficents of self and mutual induction which are of practical value in the study of the closed circuit transformer.

(To be continued.)

On the Current Strengths in Simple Circuits Containing Resistance and Capacity Under Periodic Impressed Electromotive Forces of the Recta gular Wave Type.

BY A. E. KENNELLY.

In THE ELECTRICAL WORLD for March 18, page 203, it was pointed out that when an alternating E. M. F. of the rectangular wave type, Fig. 1 (or its equivalent, a uniform E. M. F. reversed periodically by a perfectly adjusted pole changer), acted upon a circuit containing resistance only, the effective current strength followed Ohm's law $\frac{E}{R}$ simply, but that the introduction of non-ferric inductance into the circuit reduced this current in a definite way. We now consider the effect of introducing capacity instead of inductance. In Fig. 2 the coil of inductance, l_1, is replaced by a condenser of capacity K farads, and the inductance, l_2, of the dynamometer must at present be assumed to be negligibly small. As before θ is the duration of each contact in the pole changer, or the semi-period of alternation, and we have to find the current strength in the circuit for different values of θ, the total resistance of battery, leads and dynamometer being R, as before.

It can be shown that the instantaneous current strength at any time t (less than θ) after a reversal is

$$c = \frac{E}{R}\left(\frac{2\,\varepsilon^{-\frac{t}{KR}}}{1+\varepsilon^{-\frac{\theta}{KR}}} - \frac{}{}\right)$$

and the effective current which will be steadily indicated by the dynamometer, under the influence of this periodically varying current will be

$$C = \frac{E}{R}\sqrt{\frac{\tanh\frac{x}{2}}{\frac{x}{2}}} \quad \text{where } x = \frac{\theta}{\tau}$$

and $\tau = K\,R$, the time constant of the circuit.

The factor under the radical sign is never greater than

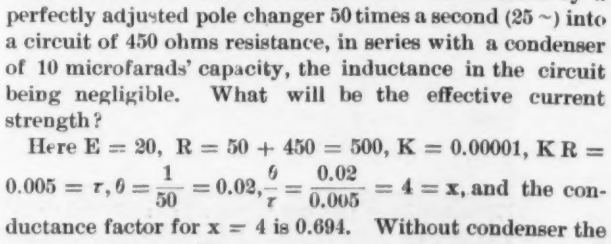


FIG. 1.

unity, and may be called the conductance factor, its reciprocal the corresponding impedance factor.

From this formula the following table is obtained:

x.	Impedance factor.	Conductance factor.	x.	Impedance factor.	Conductance factor.	x.	Impedance factor.	Conductance factor.
0.1	1.0004	0.9996	1.8	1.1209	0.8921	18 0	3.0	0.3333
0.2	1.0017	0.9983	2.0	1.1459	0.8726	20.0	3.163	0.3163
0.3	1.0038	0 9963	3.0	1.2873	0.7770	25.0	3.536	0.2828
0.4	1.0066	0 9934	4.0	1.4404	0.6942	30.0	3.873	0.2582
0.5	1.0103	0 9898	5.0	1.5919	0.6281	40.0	4.472	0 2236
0.6	1.0148	0.9852	6.0	1.7364	0.5760	50.0	5.0	0.20
0.7	1.0201	0.9804	7.0	1.8747	0.5333	60.0	5.478	0.1825
0.8	1.0261	0 9747	8.0	2.007	0.4983	80.0	6.324	0.1581
0.9	1.0328	0 9681	9.0	2.1216	0 4713	100.0	7.071	0.1414
1.0	1.0402	0.9615	10.0	2.2361	0.4472	150.0	8.660	0.1155
1.2	1.0570	0 9461	12.0	2.449	0.4083	200.0	10 0	0.10
1.4	1.0762	0.9294	14 0	2.646	0.3779			
1.6	1.0976	0.9110	16.0	2.828	0.3536			

From this table the accompanying curves have been traced (Fig. 3). It will be seen that when $x = 0$ both impedance and conductance factors are unity. That is to say, when θ is a very small fraction of the time constant K R, so that the reversals are very rapid relatively to the capacity and resistance in the circuit, the current strength remains at the valuation of Ohm's law, and the condenser has practically no effect. It has no time to charge. As the time of contact θ lengthens, the condenser begins to charge and discharge, keeping the current back, and increasing the impedance factor. At $x = 50$, or $\theta = 50\,K\,R$, the impedance factor has reached the value 5.0, and the conductance factor 0.2. Beyond $x = 100$ the change in conductance is comparatively slow, and the impedance factor becomes practically $\sqrt{\frac{x}{2}}$.

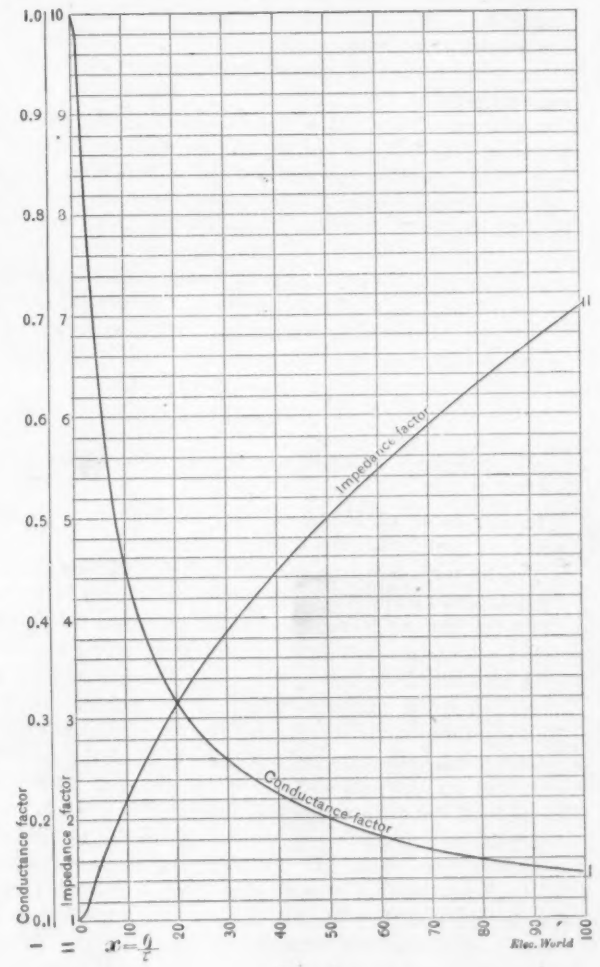


FIG. 3.

As an illustration of the case, suppose a battery of 20 volts and 50 ohms internal resistance to be reversed by a perfectly adjusted pole changer 50 times a second (25 ~) into a circuit of 450 ohms resistance, in series with a condenser of 10 microfarads' capacity, the inductance in the circuit being negligible. What will be the effective current strength?

Here $E = 20$, $R = 50 + 450 = 500$, $K = 0.00001$, $K\,R = 0.005 = \tau$, $\theta = \frac{1}{50} = 0.02$, $\frac{\theta}{\tau} = \frac{0.02}{0.005} = 4 = x$, and the conductance factor for $x = 4$ is 0.694. Without condenser the current would be $\frac{20}{500} = 0.04$ ampère by Ohm's law, and with the insertion of the condenser, after the pole changer had become steadily active, the current will be reduced to $0.04 \times 0\,694 = 0.02776$ ampère.

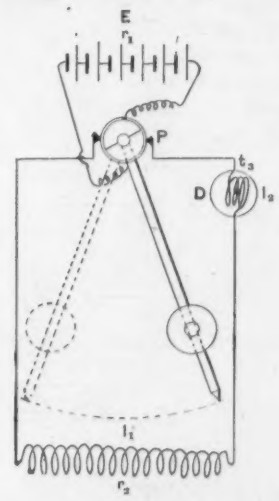


FIG. 2.

The effect of inductance, resistance, and capacity conjointly upon the current strength in such circuits may be deferred.

Mr. A. E. Kennelly, in a recent communication, calls attention to a misprint in his article on "The Current Strengths in Simple Circuits Containing Resistance and Inductance Under Periodic Impressed Electromotive Forces of the Rectangular Wave Type," which appeared in The Electrical World of March 18, page 203. The equation at the foot of the middle column should have read:

$$c = \pm\frac{E}{R}\left\{1 - \frac{2\,\varepsilon^{-\frac{t}{\tau}}}{1+\varepsilon^{-\frac{\theta}{\tau}}}\right\}$$

* THE ELECTRICAL WORLD, May 14, 1892.

The Calculation of Alternating Current Motors.—II.*

BY E. ARNOLD.

From the equation (9) for the efficiency

$$g = \frac{E_c}{R_1 I_1 + E_c}$$

it will be seen that it becomes greater the greater the counter E. M. F., because, for a given load on the motor

$$A_s = \frac{E_c I_1}{2}$$

I becomes smaller the larger E_c, that is, the greater the intensity H of the magnetic field. Apart from the changes of the losses occasioned by hysteresis and Foucault currents with different excitations, the efficiency of the motor becomes a maximum when the energy used in the excitation of the magnet plus $R_1 I_1^2$ becomes a maximum.

If we assume that the excitation is constant for all loads, then a synchronous motor will act similarly to a shunt machine for continuous currents. Every load will correspond to a certain definite current; when the reaction of the armature on the field magnet, and the resistance of the armature are negligibly small, then the speed of a shunt motor will be constant. That the current becomes proportional to the load at any moment may for both motors be attributed partly to an electrical process. If, in a shunt motor, for instance, the load increases, the speed will at first fall, and therefore also the counter E. M. F., which will increase the armature current; the increased current will weaken the magnetic field, and therefore also the counter E. M. F., which will cause a further increase of the current, but at the same time also an increase in the speed; the final result will therefore be a new state of equilibrium at a somewhat lower speed.

With a synchronous alternating current motor the same will take place, only that a change in the speed corresponding to the load cannot take place. But the rotating armature will lag behind the synchronous action through a variable angle which, however, is constant for any given torque. The phase of the counter E. M. F. will then no longer coincide with the phase of the current I, as was assumed in Fig. 3,† but the armature current will become a maximum before the counter E. M. F. does.

If α represents the phase difference between I_1 and E_c

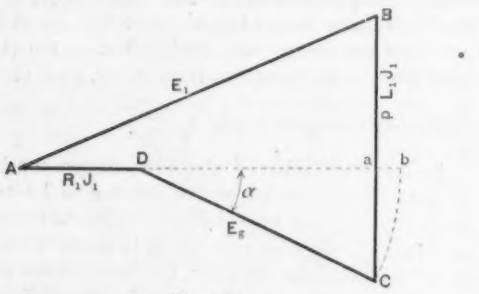


FIG. 4.

then Fig. 4 will give the relation of the electromotive forces. Then

$$E_1^2 = (R_1 I_1 + E_c \cos \alpha)^2 + (p_1 L_1 I_1 - E_c \sin \alpha)^2$$

and

$$A_s = \frac{E_c I_1}{2} \cos a \qquad (2a)$$

If the assumption is made that the field magnets are so over saturated, and that the number of the armature windings so small that the reaction of the armature current can be neglected, then E_c will be constant because the speed of the motor is constant. The increase of the current I_1 with the angle α can then be determined from Fig. 4. If $\alpha = 0$, I_1 will be equal to I_0 and in general

$$I_1 = I_0 + \frac{ab}{R_1} = I_0 + \frac{I - \cos \alpha}{R_1} E_c$$

or

$$I_1 = \frac{\sqrt{R_1^2 E_c^2 + (R^2 + p^2 L_1^2)(E_1^2 - E_c^2)} - R_1 E_1^2}{R_1^2 + p^2 L_1^2} + \frac{1 - \cos \alpha}{R_1} E_c \qquad (14a)$$

If R_1 is assumed to be negligibly small, then $\alpha = 0$, and it follows as before according to equation (14) that

$$I_1 = \frac{\sqrt{E_1^2 - E_c^2}}{p L_1} \qquad (14)$$

NON-SYNCHRONOUS MOTORS.

The characteristic difference between synchronous and non-synchronous motors is that in the former the excitation of the armature (see Figs. 1 and 2) is by means of a continuous or a redressed alternating current, while in the latter the field of the armature is generated directly by the alternating current. The armature is for that reason provided with short circuited windings, which, like the secondary windings of a transformer, are under the influence of the inducing action of the alternating current in the field windings. A non-synchronous motor therefore, like a transformer, contains an inducing and an induced system of windings, one of which is mounted so as to be capable of rotating relatively to the other. The induced system is determined according as it is for single phase, two phase, or three-phase currents.

Among the well known non-synchronous motors belong the two-phase motors of Tesla and the three-phase or "drehstrom" motors. Lately the single phase alternating current motors have been introduced into practice with excellent results. The Oerlikon company constructs non-synchronous single-phase motors in standard types of the following sizes, for 110 volts: ¼, ½, ¾, 1½, 2, 3, 4½, 6 and 9 h. p. In Chur (or C'oire, Switzerland), where this company has installed an alternating current plant, the first motor of this kind was put into practical operation in December of last year; it is a 2 h. p. motor, and is used to drive the printing machinery of the newspaper called the "Neuen Buendner Zeitung." A second motor of 4½ h. p.

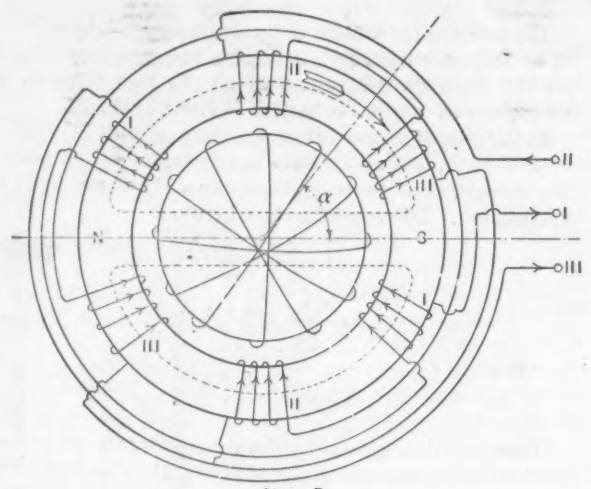


FIG. 5.

has just been installed, and another of 9 h. p. is used for starting a 100 h. p. synchronous motor in the mill of Messrs. Lendi & Parli. These motors have, like multiphase motors, neither collector, brushes nor contact rings and their efficiency is nearly like that for multiphase current motors.

The two phase and the multiphase motors have the property of starting from a state of rest, with a torque, but the single phase motors require special arrangements for starting. In order that they may reach their proper speed it is necessary to give the rotating part a certain starting speed, after which the motor will of itself increase its speed nearly to that of synchronism and can then be loaded. The starting speed can be given it either by mechanical or by electrical means; for small motors a start with the hand will suffice.

It will be of interest to see in what way the torque depends on the electrical and on the mechanical factors; at first I will consider the multiphase motors. In Fig. 5 is shown diagramatically a three-phase motor; it is bi-polar and the angles of the three phases are: 0°, 120° and 240°; the field winding, which is assumed to be stationary, consists of six coils, and the phase difference of the currents in neighboring coils is therefore 60°. The armature has a number of short-circuited windings, and is mounted so as to rotate with respect to the field.

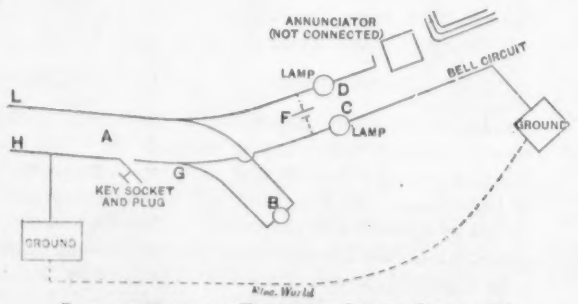
(To be concluded).

Solution to an Electric Light Problem.

In our issue of March 25 we gave an electric light problem, which, briefly, was as follows:

The battery, F, of an electric bell circuit was replaced by a tap on an electric light service, as shown in the cut. With the annunciator disconnected, the lamp B lighted to full candle power when the socket was turned on, and C and D showed no light, but when the key socket was turned off the lamps B and C were lighted to about half candle power.

The cause was a ground on the leg H of the lamp circuit and on the bell circuit. When the key socket was turned off the current passed through the main L to the lamp B, to G, and thence through C to the ground, and finally to the main H. As there were two lamps in series, only half of the normal current passed through the lamps, and they lighted dimly. When the key socket was turned on, the current returned to the dynamo through the slight resistance of the main H, only an in-



SOLUTION TO AN ELECTRIC LIGHT PROBLEM.

finitestimal portion passing from G through the high resistance of the lamp, which therefore remained unlighted.

This case, which actually occurred as stated, shows the inadvisability of connecting an electric light service with electric bell circuits, which have an entirely inadequate insulation.

Correct solutions were received from J. Oliver Johonnot, T. H. Reardon, John J. Berger, Chas. A. Lindner, John T. Cowling, H. S. Battles, Wm. Paca, F. C. Tomlinson, W. J. Barnes, James McKimand and George Pole.

The Electrical Exhibit at the World's Fair.

Much has been said and written and much expected of the coming exhibition of electrical apparatus and effects at the World's Fair, which is to mark for this country the progress that has been made since the Centennial at Philadelphia in 1876, and for the world since the electrical exhibits at Frankfort and the Crystal Palace a year or two ago.

In this country no exhibition of note had been made previous to 1876, and since then, while there have been numerous ones of considerable magnitude, there have been none comparable in extent to those made abroad at the various exhibitions that have been given in Paris, St. Petersburg, Frankfort and London. Our people are, therefore, prepared for a display of great magnificence and in this they will surely not be disappointed, and the visitors from abroad, while prepared for the same thing, will look upon the coming exhibition with the critical eye of the connoisseur and will draw comparisons with those fine exhibits with which they have been familiar in their own country. They will come expecting to find a distinct advance over anything they have heretofore seen, nor in this, we are assured, will they be disappointed. While the descriptions which have been published of the coming Chicago display have been numerous and well written, they have been more general in character than specific, and the reader has been left in most cases to fill up from his imagination the details of the picture thus generally outlined to his view. In a few cases the articles have been more specific in their nature and particular displays have been given in greater detail, and the mind has been enabled to more firmly grasp the beauties of such exhibits by more or less truthful pictorial illustrations of these various displays. The Electrical World has been foremost in descriptions of this kind, and its beautiful two-page supplement of the electrical fountains at the World's Fair and the full page night view of the electrically illuminated Administration Building may be referred to as noteworthy instances of this kind. This week we are enabled to present to our readers another full page illustration of the most gorgeous exhibit in the Electricity Building, and one which will probably find lodgment in our memories long after many other details of this magnificent display shall have passed from recollection. As those who have followed the published accounts of the allotment of space will remember, the real post of honor in the Electricity Building has been allotted to the Phoenix Glass Company for their display, and that immediately surrounding this on all sides, extending in both directions down the transept and nave, will be located by far the most extensive exhibit in the whole display, namely, that of the General Electric Company. It would seem but natural that these two interests should unite to make this grand central piece the most magnificent of all, and such has been the case, as is illustrated on the opposite page, where the enormous glass shaft, extending to a height of 72 feet from the floor, is the combined exhibit of the Edison Lamp Works, an important department of the General Electric Company, and the Phoenix Glass Works before noted. While the details of this picture, we believe, are correct in all essential particulars, no reproduction can do justice to the brilliant effects which the display itself has in store for the visitor. As will be seen, this stately shaft is thickly studded with incandescent lamps, and these with their vari-colored globes will be fed from numerous independent circuits, capable of ready commutation with the source of supply, so as to throw into vision in pleasing combination and kaleidoscopic changes the varying hues of the ever beautiful rainbow. In keeping with these the powerful arc lamp, which surmounts the brilliant pile will be surrounded by prisms of cut glass in lieu of a shade, which at the varying angles will refract in their purity the elementary colors of which its light is composed. Surmounting all other exhibits and extending high above the floors of the gallery this monument of electrical progress will be a fitting centre for the magnificent setting from which it springs, and will be the first to rivet the attention of the visitor from whichever direction he may enter the building, and as before stated will probably be the last to be obliterated from the tables of his memory, upon which so many brilliant scenes will have been inscribed during his visit to this, the greatest and most brilliant of electrical exhibits the world has ever seen.

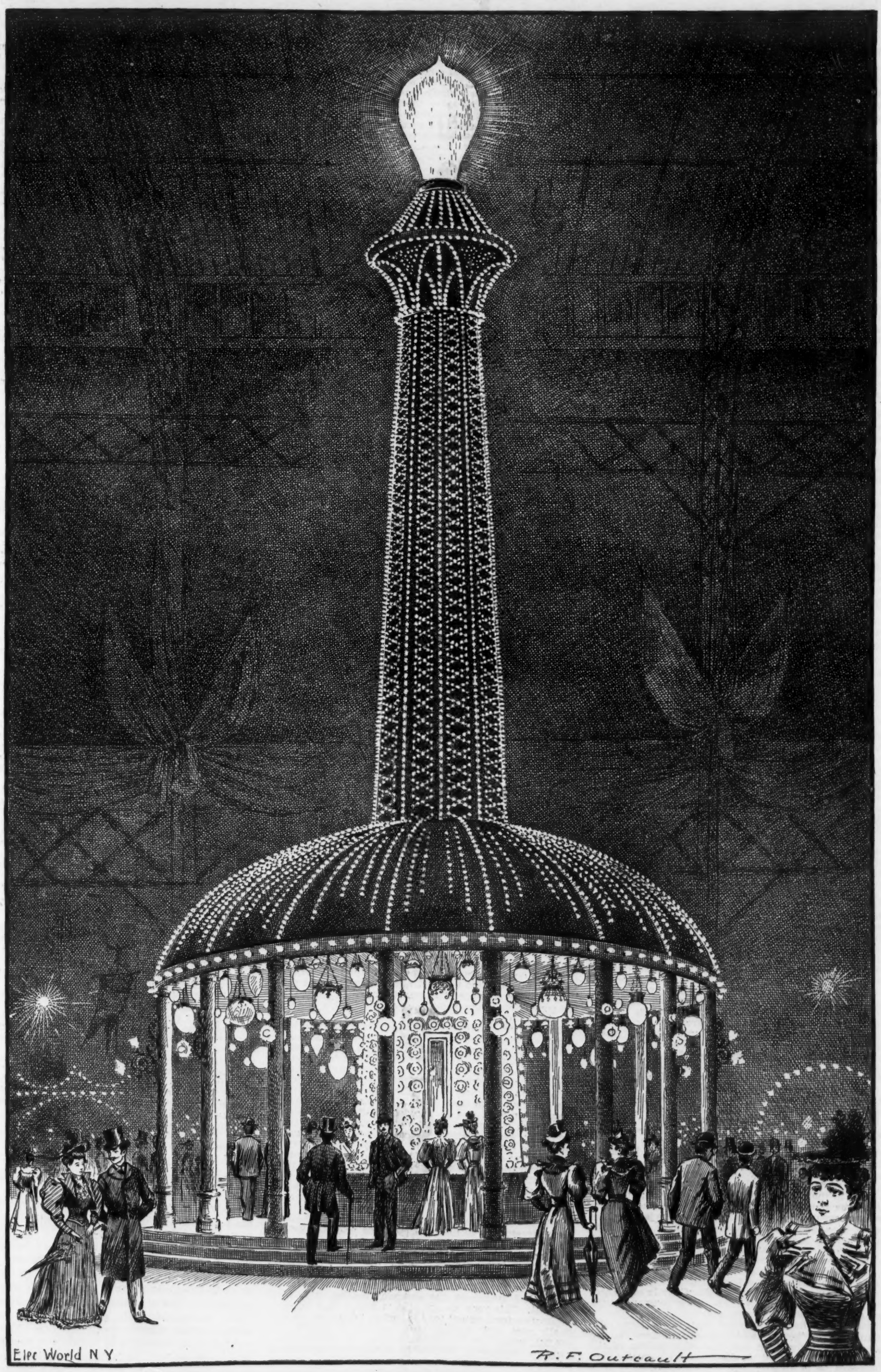
Long Distance Telephony.

Mr. Charles A. Brown, of Chicago, writes us as follows:

Referring to the article on the telephone situation in your issue of the 18th, the writer of that article conveys the impression that the instruments used for transmitters in the long distance talking carried on between New York and Chicago, over the Postal Telegraph Company's compound wire, when the Postal line was first completed, were magneto-telephones. The instruments used for this purpose were special compound Edison carbon transmitters. The wire used was No. 4 gauge, and it should be noted also that in these experiments the western end of the line terminated outside of the city of Chicago, and thus the underground conductors leading from the city limits to the centre of the city did not form part of the circuit.

*For the first part of this article see THE ELECTRICAL WORLD, Jan. 21, 1893, p. 49.

† See THE ELECTRICAL WORLD, Jan. 21, p. 49.



THE CENTRAL EXHIBIT OF THE ELECTRICITY BUILDING.

Fearing that we might be in error, as Mr. Brown avers, we have taken pains to look the matter up. The main point which we intended to make was that it was possible to communicate over long distances without the use of microphone transmitters. Perhaps we were mistaken in regard to magneto-telephones having been used over the New York-Chicago line, but we are assured by some who were at this end of the line that they were, and by some that they were not. As different instruments were tried on different days, it is probable that both are right. That Cleveland was thus reached seems beyond doubt. The noises spoken of in the following letter were undoubtedly due to the grounded circuit and induction and not to the transmitter used.

The letter will be read with interest in this connection:

Boston, March 27, 1893.

To the Editor of The Electrical World:

Sir: Replying to your letter of the 25th for the facts about the Postal company's compound Chicago-New York line, they are as follows:

The line wire was a large Brown & Sharpe No. 4. Its size was 7-32ds of an inch, or 219-1000ths. Its steel core weighed 200 pounds per mile; copper to the extent of 500 pounds per mile was deposited on such core; resistance per mile, 1 7-10 ohms.

As to the transmission, the line was thrown open, first, New York to Cleveland. Everybody that wanted to tried their own patented telephone—the Hopkins mercury, the Baxter or overland, the Shaw and others. I tried a Bell magneto instrument on it, and it worked all right as a transmitter, although the line was a noisy one. As between New York and Cleveland it was altogether a question of conductor; and the instrument was not material; although the several promoters of new telephones loudly proclaimed the special excellence of their own instruments.

In the Chicago experiments, which took place a few weeks later, again several instruments were tried, but the line was very noisy as a general thing, and the best results by far were those reached in connection with Edison soft carbon transmitters, having a single mouthpiece for both, independent primary circuits and batteries, and secondaries in series.

I have no recollection of a magneto transmitter having been used to Chicago.

See "The Operator" and The Electrical World, 1883, pp. 150, 166, 200, 230, 258, especially 200 and 258.

Also "Scientific American," 1885, March 17, p. 161, and March 24, 1883, p. 176.

Also "Electrician" (London), March 31, 1883, p. 458, and the "Electrical Review" (London), March 31, 1883, p. 272; April 7, p. 282; April 21, p. 334; April 28, p. 360, and May 12, 1883, p. 387.

These are the facts. THOS. D. LOCKWOOD

Annual Report of the American Bell Telephone Company.

The American Bell Telephone Company has issued its thirteenth annual report for the year ending December 31, 1892. The main body of the report, which is signed by J. E. Hudson, President, is here given in full, the tables of statistics, ledger balances and report of Auditing Committee being omitted:

Regarding the increase of business during the year 1892 throughout the country, it will be observed that only one of the previous eight years shows so large a gain in the number of exchange stations reported by the operating companies.

And not only has there been a large increase of subscribers, but an interesting feature of the statistics, of which mention has been made in earlier reports, is the increase of the average daily use, by each subscriber, of the local exchange service. In 1892 this average of use was greater by 10 per cent. than in 1891, being least in the small exchanges, and following a fairly well graduated scale of increase to the highest average, which is found in the large cities. The computed total number of exchange connections yearly throughout the United States has advanced from 312,605,000 in 1886 to 600,000,000 in 1892.

The general average of such connections originating at each station is 8 1-20 per day; that is, each subscriber on the average is placed in communication upward of 16 times with others in the same exchange, as compared with an average of 11 6-10 times, which was the record of six years ago. This constantly growing use of the telephone may be attributed to three causes; first, familiarity with the use of the instrument, and its vast convenience in finishing business by sending the message and receiving the answer in one act; second, the larger number of correspondents with whom, as the exchange increases, each subscriber may be placed in communication; third, the greater confidence—due to better construction and supervision of lines and apparatus, and to the improvements of service consequent upon the employment of experienced and highly skilled officials—which the subscriber has in the telephone system as a trustworthy means for the transaction of important business.

The increase in the number of subscribers and the rapidly increasing frequency in the use of the lines are, of course, in part but the evidence of improvement in the plant and in the character of the service given; and it is with gratification that the large addition to the number of subscribers for the metallic circuit service is noted, as a proof of appreciation of the advantages which this class of service is found to afford. At the beginning of the year the exchange stations having the metallic circuit equipment numbered 11,584, and at the close of the year they numbered 23,053.

The criticism has at times been made that the rates at which the service is furnished to subscribers in our larger cities are disproportionately high, when compared with those charged in smaller exchanges.

Setting aside the consideration that, in the large city containing some thousands of exchange stations, the use made by each subscriber, and the value to him of the telephone facilities, must inevitably be much greater than they would be in an exchange of less importance, it is also the fact that, in exchanges above the limit of a few hundred subscribers, the cost of maintaining and operating each station bears a close relation to the numerical size of the exchange, and the extent to which each station is used, rising in the largest cities to an amount several times as great as the cost in the average of the small exchanges. The necessity of bringing the service to the highest attainable standard of excellence to meet the needs of a great business community; of employing a corps of the best skilled officials large enough to meet any probable emergency of the service; the higher rates of wages, rents, taxes, transportation, which prevail in the large cities; the expensive character of the construction and maintenance inseparable from the conduct of business in densely populated sections, where proximity with electric light and power currents is difficult to avoid—combine to enhance the cost to the company operating the telephone exchange. While these facts are doubtless recognized by the subscribers in the large exchanges, it has seemed appropriate to call attention to them in connection with the subject of the relative use of the service in the small and large exchanges, and in the last year as compared with preceding years.

It is admitted generally that, in point of convenience, celerity and certainty, the telephone service has proved its superiority to any other method of communication.

It can justly lay claim to the further advantage that, taking together the average of exchange use, and the cost to the subscriber, it has become a less expensive means of communication than the others commonly employed, not excepting the United States mail.

The work of connecting together the territories of the different licensees has taken a great step forward. It will be remembered that in the last report the intention was announced of the Long Distance Company of filling the gap between Cleveland, O., and Hammond, Ill., thus giving through service between Boston, New York and Chicago. This has been done—that company having added to its construction during the year, 494 miles of pole line, and 8,645 miles of wire, of which 365 miles represent the extension from Cleveland to Chicago, about 74 miles; a spur connecting Detroit, by the way of Toledo, with the through line, and the remainder; some 93 miles, the joint construction and reconstruction upon the Hazleton and Altoona line, in Pennsylvania. Of the added mileage of wire, 7,150 miles are strung on the New York-Chicago line; the remainder are wires added to the existing system, chiefly in the New England States and Pennsylvania.

The general route of the line to Chicago is by the way of Newark, N. J., Harrisburg and Pittsburgh, Pa., Cleveland and Toledo, O., and South Bend, Ind.

To determine the feasibility of transmitting speech over the theretofore unapproached distance of one thousand miles—the limit of the successful transmission of speech had not before exceeded 500 miles—a special experimental circuit, consisting of two number 8 hard-drawn copper wires, was constructed. This wire weighs 435 pounds to the mile, and the circuit contains 826,500 pounds of copper. A circuit of the weight generally used for telephone service would weigh less than 200,000 pounds.

The success was so complete that the lines were at once extended to Boston, and two more circuits ordered strung from New York to Chicago.

The connecting of these cities together, and the furnishing of apparatus for personal conversation between them, were such an addition to the facilities of business as by sort of common consent to be recognized as a matter of public concern.

The line from New York to Chicago was formally opened to the public on the 18th of October last, and the line to Boston on the 7th of February, 1893, when His Excellency Gov. Russell opened the line by conversation with the company's officers in the office at Chicago. The formal opening in New York was made by his Honor, Mayor Grant, at the company's office in New York, who conversed with his Honor, Mayor Washburne, in Chicago, at the company's office in the last named city.

It is now possible from this room, or from any properly appointed station on this system, to talk north and east to Augusta, north to Concord, N. H., to Buffalo, N. Y., west to Chicago and south to Washington, and, of course, to the principal cities intermediate.

In the Eastern States connecting lines already reached all important points. As said, a spur has been built to Detroit by way of Toledo. A line had previously been built from Chicago to Milwaukee. Through these branches and through contemplated connecting lines of local companies, all important points in Ohio, Indiana, Illinois, Michigan and Wisconsin as well, will soon be reached.

It may be interesting to note that within that territory live and do business something more than one-half of the whole population of the United States, so that soon it will not be a figure of speech to say that one-half of the population of the country are within talking distance of each other.

That this constitutes an addition to the social and business facilities of the country of far reaching consequence needs, of course, not to be added. Nor, I suppose, needs it to be said that such a performance taxes to the uttermost the technical resources of the companies in construction and equipment, and in an equal degree their vigilance in inspection and maintenance.

In building these lines, in building plants to meet the growing business, and in bringing existing plants up to the level of our improved knowledge, and adapting them for use on such an extended scheme, and in yielding to the public demand in the more thickly settled portions of the larger cities that the wires should go underground, in these various branches of work from 1885 to 1892, principally, however, in the last five or six years of that period, there has been expended, after ample allowance made for repairs and maintenance, no less a sum than $35,737,049.14.

This, of course, it will be observed, takes no note of the large investments in the business made prior to 1885.

In the last annual report it was stated that the long pending application of Berliner for a patent for the microphone, an invention acquired by the predecessors of this company in the early days of telephones, had been allowed by the Commissioner of Patents, and that the patent had issued to the company bearing date Nov. 17, 1891. This year we are able to report that Edison's application for a patent for the carbon telephone has also finally met with success and resulted in patent, No. 474,231, granted to the Western Union Telegraph Company as assignee of Edison, May 3, 1892. The carbon telephone patent will be controlled by this company under its agreement with the Western Union Telegraph Company. It is necessary to add, however, that Edison's foreign patents for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patent. Our counsel inform us that the law is unsettled, whether in such cases the American application should be defeated by the expiration of the foreign patent, but that the better opinion is that the expiration of the foreign patent is immaterial.

The expiration on March 7, 1893, of United States patent, No. 174,465, issued to Prof. Bell, occasioned some confusion in the public mind, owing to the fact that it was not clearly understood that Prof. Bell's patents were two in number, the second of which, No. 186,787, dated Jan. 30, 1877, will continue in force until Jan. 30, 1894. The subject matter of this second patent was defined as follows by Mr. Chief Justice Waite in giving the decision of the Supreme Court of the United States in The Telephone Cases (126 United States Reports, 572):

> The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patents rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action: the fifth, of a prrmanent magnet constructed as described with a coil upon the end or ends nearest the plate; the sixth, of a sounding box as described: the seventh, of a speaking or hearing tube as described for conveying the sounds; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used.

An impression has also gained some currency, that the patents upon the Blake transmitter, expired Jan. 20, 1893, because of the expiration on that date of certain foreign patents which were taken out on Mr. Blake's inventions. While it is true that these foreign patents were granted before the United States patent was issued to Mr. Blake, it is also true that Mr. Blake's original application was filed in the United States before any application abroad, and under these circumstances—although the point has not been decided by the Supreme Court of the United States—it seems to be the better opinion, as said in speaking of the Edison patent, that the patents on the Blake transmitter are still in force.

Moreover, it should be borne in mind that the instrument commonly known as the Blake transmitter embodies other patents besides those issued to Mr. Blake, notably certain patents issued to Edison and Berliner, and this fact is indicated upon the instruments themselves.

In the case of The United States vs. The American Bell Telephone Company and Alexander Graham Bell, the court on Jan. 25, 1892, allowed the defendants until Oct. 1, 1892, within which to take their evidence, with the understanding that additional time would be granted if they decided to introduce evidence to meet the testimony taken by the complainant in relation to Daniel Drawbaugh. The time so allowed was spent in taking evidence relating to the history of Mr. Bell's inventions set forth in his two-patents in suit; and then the defendants made application for further time in which to introduce countervailing evidence upon the Drawbaugh issue. The court, after hearing counsel for the respective parties on that application, Nov. 25, 1892, decided that the defendants were entitled to as much time, if they needed it, for taking their evidence, as the complainant had consumed in taking its evidence; and accordingly an order was entered allowing an installment of three months, with liberty to apply for an extension at the end of that period, and so on until the defendants had had two years from the date of the first order, Jan. 25, 1892. On Feb. 25, 1893; the defendants applied to the court for another installment of time, and they were allowed until Aug. 25, 1893.

One of the latest acts of Attorney-General Miller, before retiring from his office, was to institute a suit to annul the Berliner patent. For that purpose, the Government filed its bill of complaint in the Circuit Court of the United States for the District of Massachusetts, against the American Bell Telephone Company and Emile Berliner. The bill was filed Feb. 9, 1893. It charges particularly that the original application did not cover the microphone, but was only made to do so by unlawful amendments, that Berliner was not the original and first inventor of the microphone, and, above all, that the progress of the application in the Patent Office was wrongfully delayed.

In the course of proceedings the brief or argument which had been filed with the Attorney-General and on which he was asked to take action, was sent to the Interior Department and the Patent Office for consideration and report. The commissioner gave the matter exhaustive examination, and said in conclusion:

"I do not believe that a suit to repeal this Berliner patent is justifiable."

This report was sent to the Hon. the Secretary of the Interior, who in turn sent it to the Attorney-General with a communication containing an expression of his own belief that Berliner's was the mind that made the invention covered by the patent, that the amendments complained of were made in due course, and that there were no extraordinary delays in the prosecution of the patent imputable to Berliner or his representatives.

I am advised that it is without precedent for the Department of Justice to bring a suit to annul a patent without first obtaining from the department of government, from which the patent issued, an expression of opinion that the suit ought to be brought.

Remarkable Instance of Expansion by Heat.

The New York "World" of March 24 is responsible for the following delightful bit of information. A Brooklyn trolley wire had broken and——

"While the wire was hanging it had become heated until, in parts, it had expanded to a diameter of several inches. All along the block the red-hot metal squirmed in snake-like gyrations from curb to curb, sizzing in the gutters and hissing in pools between the tracks."

Our enterprising daily contemporary is anxious for news, and has certainly got it this time. The tables of coefficients of expansion of metals will now have to be thoroughly revised. It is rather surprising that the reporter did not say that the trolley wire had expanded to a diameter of several feet instead of inches. Perhaps it was a typographical mistake.

Non-Synchronous Motors for Ordinary Alternating Currents.

BY E. ARNOLD.

The well known experiments of Prof. Elihu Thomson and the work of Nikola Tesla have laid the foundation for the construction of a practical non-synchronous alternating current motor. There were, however, quite a number of obstacles to overcome in order to carry out the principles in practice; it is only since the very extended experience in the construction and operation of multiphase motors has been had that the construction of single phase motors has become easier, and there are now a number of such motors in commercial use.

Prof. Thomson was the first to show that a conductor, mounted so that it can rotate, and placed in an alternating magnetic field, will, after being started, or if unsymmetrically placed in the field, attain a high speed and show the tendency to retain this speed. If instead of this simple massive conductor, an armature with laminated iron is used, containing a number of short-circuited windings of copper bars, the action will become very much greater and the armature will now attain an approximately synchronous speed, delivering considerable power without loss of speed.

An alternating current motor constructed according to this principle therefore consists of an inducing system of windings and one in which induction takes place; the latter is generally mounted so as to revolve, and forms the so-called short circuit armature; these windings are either short-circuited singly or in groups; there are, therefore, no brushes nor collectors. The direction of rotation of such a motor is determined by the direction in which it is started.

A very interesting method for starting the motor is shown in the U. S. patent No. 401,520, of Feb. 18, 1889, by Mr. Tesla. The inducing winding is divided into two parts, whose self-induction is different. To start the motor, the two parts are connected in parallel; on account of the phase difference of the two currents, there will be produced a rotating field; the motor will, therefore, start and in a very short time attain an almost synchronous speed. The second winding can then be disconnected, or connected in series with the first.

It may be of interest to reproduce here the claims of this patent. The illustrations need not be reproduced, as they are the same as Figs. 3, 4 and 5, reproduced in The Electrical World, Feb. 25, p. 139, which were published in Mr. Brown's article, and which correspond exactly with those in Mr. Tesla's patent.

Claim 1. The method of operating an alternating current motor herein described by first progressively shifting or rotating its poles or points of greatest attraction, and then, when the motor has attained a given speed, alternating the said poles as described.

2. The method of alternating an electromagnetic motor herein described, which consists in passing through independent energizing circuits of the motor alternating currents differing in phase, and then, when the motor has attained a given speed, alternating currents coinciding in phase as described.

3. The method of operating an electromagnetic motor herein described, which consists in starting the motor by passing alternating currents, differing in phase, through independent energizing circuits, and then, when the motor has attained a given speed, joining the energizing circuits in series and passing an alternating current through the same.

4. The method of operating a synchronizing motor which consists in passing an alternating current through independent energizing circuits of the motor and introducing into such circuits a resistance and self-induction coil, whereby a difference of phase between the currents in the circuits will be obtained, and then, when the speed of the motor synchronizes with that of the generator, withdrawing the resistance and self-induction coil, as set forth.

Claims 2 and 3 are particularly characteristic. That Tesla was, as far as can be ascertained, not quite successful in producing a good alternating current motor is due to the magnetic disposition, for in the Tesla motor there are prominent projecting poles. Its cause may be explained as follows:

In an article by the writer in the "Elek. Zeitschrift," No. 3, p. 31 (abstracted in The Electrical World, Feb. 11, p. 109, under the heading of "Doubling the Frequency"), it was shown that two coils, perpendicular to each other, which rotated synchronously in a fixed alternating field, will have alternating currents induced in them whose frequency is double that of the exciting current and whose phases differ by one-quarter of a period. The evenly distributed windings on the circumference of a short-circuited armature, we may suppose to be replaced by two such windings. If we now examine the magnetic fields which the currents induced in these coils produce, then below saturation one field will be proportional to the current

$$\frac{H f p}{R} \sin^2 p t,$$

and the other will be proportional to the current

$$\frac{H f p}{R} \cos^2 p t$$

in which

H is the maximum intensity of the magnetic field produced by the exciting current and which is supposed to be homogeneous.

f is the inclosed surface of the winding of the armature.

R the resistance of the same.

p equals $2 \pi n$, in which n is the frequency of the exciting current.

The two magnetic fields have the tendency to combine into a rotating field of a constant strength, which is proportional to

$$\frac{H f p}{R}.$$

We thus obtain an ideal rotating field which at synchronism of the armature revolves in the opposite direction with the angular velocity p. If the angular velocity of this rotating field—that is, the angular velocity of the armature—is diminished, the mutual action between the primary field and the rotating field will tend to keep up synchronism. A magnetic disposition which is favorable for maintaining the rotating field, and which has as low a magnetic resistance as possible, is evidently that which should be sought for; this will be the case when the armature is surrounded by as continuous a mass of iron as possible; that is to say, prominent projections and poles are to be avoided both on the magnetic field and on the armature. A small air space between the field and the armature iron, having wires in narrow grooves or in holes, therefore answers all the requirements. The method first suggested by Wenstroem may therefore be employed for alternating current motors with great success. This method, which has found such wide applications in continuous and alternating current machinery, and which Mr. Brown has also adopted, consists in placing the armature wires in holes near its circumference or winding it between teeth having very narrow air spaces between them.

The conditions which govern the construction of a multiphase motor apply therefore also to ordinary alternating current motors. The similarity is so great that every multiphase motor can be changed into one for ordinary alternating current. The Oerlikon company, during the past year, has introduced a series of standard

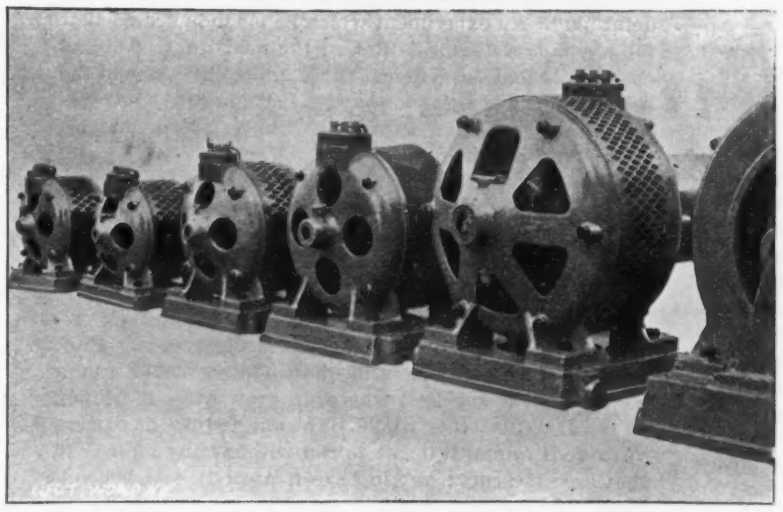


FIG. 1.]

motors, constructed for either single phase or multiphase currents, both of which have been introduced commercially.

Both motors are constructed on the same lines. The inducing winding which encircles the armature is made in the form of a ring winding, in which the wires lie in grooves in the iron core; the sheets of iron of the armature are punched with holes, in which are placed insulated copper bars, which are either connected together in common at both ends by means of copper rings, or they may be short-circuited in groups. From one-eighth to 6 h. p. the alternating current motors of the Oerlikon company are constructed as shown in Fig. 1. The larger motors have different bearings, and in general a more rigid construction. Rotary field motors are at present constructed for the following outputs: ⅛, ¼, ½, 1, 2, 3, 4½, 6, 9, 12, 18, 25, 35 and 50 h. p. A non-synchronous motor of 250 h. p., which was constructed several months ago for the transmission of power from Hochfelder to Oerlikon, is now running in the factory.

The following table gives the data for the non-synchronous motors for ordinary alternating currents, which are at present made by that company:

TABLE OF DATA FOR ALTERNATING CURRENT MOTORS FOR 110 VOLTS AND 65 PERIODS.

Horse power	⅛	¼	¾	1½	2	3	4½	6	9
Speed	1 800	1,800	1,800	1,780	1,750	1,750	1,200	1,175	1,150
Watts consumed	230	370	950	1,780	2,240	3,160	4,040	5,810	8,300
Efficiency	40	50	58	62	65	70	73	76	80
Length, on plan in mm.	370	375	445	485	515	540	600	790	860
Breadth, on plan in m.m	320	320	380	455	455	840	840	1,185	1,185
Total height	360	410	450	505	505	605	675	840	900
Diam. of pulley	120	120	140	140	160	160	250	250	250
Width of pulley	60	60	80	80	100	100	120	140	160
Weight, in kilos	42	50	100	125	150	230	275	420	550

In the city of Chur (Coire), in Switzerland, where this company has erected a central station for alternating currents, a 2-h. p. motor has been in use since the beginning of September with ordinary alternating currents, in the printing establishment of a local paper. Another of 1½ h. p. and another of 9 h. p. are also installed, the latter being used for starting a 100-h. p. synchronous motor in a mill.

The starting of single-phase motors is accomplished by the Oerlikon company in various ways, of which we will mention a few. The method of Tesla, although simple, has the disadvantage that when starting very large currents are required, in consequence of which relatively large transformers are required, which also interferes with lights connected to the circuit. Small motors, however, may be constructed so that a simple pull with the hand is sufficient to bring them to synchronism with a moderate current, after which they can be loaded.

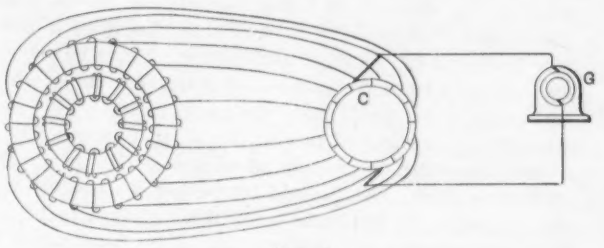


FIG. 2.

In another method, shown in Fig. 2, the field winding is similar, but is connected to the bars of a commutator, C, precisely as in a continuous current motor. As the commutator is stationary, it can be placed on the motor or on the switchboard. The current for the field is led to it by means of two brushes, which can revolve on the commutator. To start the motor the brushes are rotated by hand; the axis of the field produced in the motor will be displaced in proportion to the speed at which the brushes are moved; in consequence of the shifting of the axis, the motor starts; as soon as the motor has attained a certain speed the rotating brushes may be fixed in any position.

Lastly, we might mention another method, for which the writer applied for a patent last year, and which is precisely the same as that described by Mr. Brown in the paper above referred to. In proof of this may be given the following extract from the patent:

"The armature (Figs. 3 and 4) is of the Gramme type. Just as in a continuous current machine the single coils are connected with the segments of a commutator on which rest two brushes. In starting the motor, the primary current is not only passed through the field coil, but also through the armature coils. The alternating current motor will now operate, when the brushes are properly placed, like a series motor for continuous currents; the maximum current in the armature coincides always with the maximum field, the motor will, therefore, start under favorable conditions and will develop a torque. The resistance R connected in circuit permits the current and the torque to be regulated. As soon as the armature approximates synchronism, which takes but a very short time, the segments of the commutator are short-circuited among themselves. For this purpose there is a ring, S, insulated from the shaft and capable of bting moved on it, which, by means of a lever, is pressed between the commutator bars. The current will pressed between the commutator bars. The current will now pass directly from one brush to the other, the sparking at the commutator disappears and the armature operates like a short-circuited armature. By the application of a short-circuited device, the brushes may be taken off from the commutator entirely after the

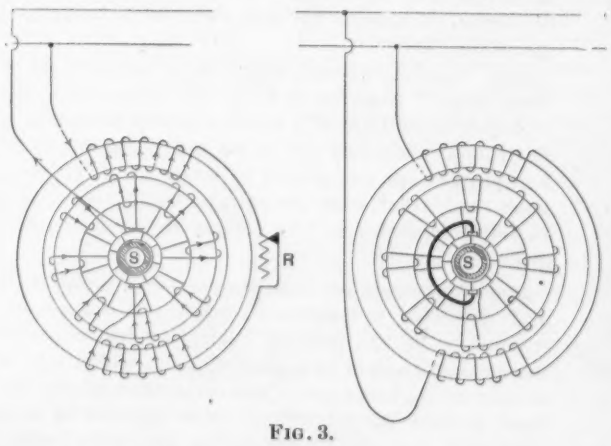


FIG. 3.

motor is in motion. By means of a centrifugal regulation the operation of the short-circuiting may be performed automatically, etc."

Cheap Light and Power.

The "Berlin Electricitats Werke," a company owning central stations in Berlin with a capacity of 200,000 16-c. p. lamps, has lately reduced the price for motor current from its incandescent mains to 4.6 cents (20 pfennigs) per 1,000 watt hours. The price for a 16-c. p. light is now .8 cents (3.5 pfennigs) per hour.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Luminous Air.—Dr. Lenard, assistant to Prof. Hertz, read a paper before the Royal Prussian Academy of Sciences (an abstract of which is contained in the Lond. "Elec. Eng.," March 17), in which he describes a novel light produced by electrical oscillations. Hertz has shown that the rays from the cathode of a Geissler tube, which are capable of producing phosphorescence, will pass through a thin sheet of metal. By closing an opening in a discharge tube, by means of an aluminium plate .003 millimetre thick, Dr. Lenard succeeded in passing rays into the open air, the plate being thick enough to be air-tight and opaque, yet thin enough to be penetrated by this discharge; the cathode is at a distance of 12 centimetres; these rays rendered the air faintly luminous; a halo of bluish light surrounded the "window" and is moderately bright only on the surface; a strong odor of ozone is emitted; phosphorescent substances held near it shine with very peculiar light; the action ceases when the rays are deflected by a magnet.

Solid Air.—Prof. Dewar, in his recent researches, has succeeded not only in liquefying air, but in converting it into a solid. It is not known yet whether this is merely a mixture of frozen nitrogen with gaseous oxygen or whether it is a true solidification of air; nitrogen is easily frozen, while pure oxygen has not yet been solidified.

Maxwell's Theory.—Mr. Cohn has found that the speed of electric propagation in water is 8½ times slower than in air; 8½ is precisely the value of the index of refraction of water as found by Mr. Ellinger. This is another verification of Maxwell's theory.—Lond. "Elec. Eng."

High Frequency Oscillations.—The Lond "Elec. Eng.," March 17, p. 276, gives a short summary of references to articles published on this subject.

UNITS, MEASUREMENTS, INSTRUMENTS.

Impressed E. M. F.—Mr. Kennelly replied to the comments of the Lond. "Electrician" on the supposed inaccuracy of the definition of impressed E. M. F. proposed by the Committee of the American Institute of Electrical Engineers. The definition was admitted to be correct if the word "activity" of the source means the rate at which it supplies energy to the circuit. (As this is the usual accepted meaning, the definition is correct.)

Thomson Meters.—In "L'Ind. Elec" Mr. Frager gives a short theoretical discussion showing that the Thomson meter gives a true value of the energy passing throught it when such energy is of a very variable kind, as, for instance, when the current is used for electric railways, elevators, workshop motors, etc.

Wattmeter.—Dr. Fleming described a new wattmeter in which the shunt coil was excited by transformers; the series coils are mounted on wood, and are capable of being moved together or apart so as to bring them near or farther from the movable coil; the mercury cups are carried on the coil itself.

Thermo-electric Thermometers.—Dr. Barus, after experimenting for a long time, is very strongly in favor of the thermo-electric method of measuring high temperatures. He considers that a couple made of platinum with an alloy of platinum and iridium or rhodium gives the best results; his opinion is the outcome of several years of difficult experimenting. His recent experiments with the fusion of igneous rocks appear in a recent issue of the "Phil. Mag."

High Resistances.—Mr. Smith in a recent issue of the "Phil. Mag." suggests making high resistances for use with galvanometers, of a mixture of dry plaster of paris, electrotype plumbago and powdered glass, mixed in certain proportions and sealed in glass tubes. (It does not seem likely that such resistances could be relied upon as being constant, as any jarring would probably alter their resistance.)

Magnetic Screens for Laboratories.—Mr. Smith in "Nature" describes a magnetic screen, which he had constructed to protect delicate laboratory instruments from the magnetic action of a large dynamo which was within 60 feet of the test room. The three sides of the dynamo room nearest the laboratory were inclosed in a double brick wall, the space between the two walls being filled with scrap iron; the iron wall is about 8 inches thick; delicate tests showed that this was an effective barrier to the magnetic influence.

DYNAMOS, MOTORS AND TRANSFORMERS.

Testing Alternators.—The discussion of Mr. Mordey's paper on this subject is contained in full in the Lond. "Electrician," March 17. Besides the abstracts already given in these columns the following are some of the most important points: Dr. Hopkinson called attention to the fact that in a continuous current dynamo the pole pieces heated, particularly where the armature passed away from them, while if used as a motor they heated where the armature approached them; if, therefore, a machine to be tested was arranged with two commutators, in such a way that the current from one section of the armature opposed that of the other, this heating would be considerably diminished and an efficiency higher than the true efficiency would be obtained. Mr. Mordey's method of testing single alternators was open to a certain extent to the same objection. Mr. Kapp, referring to the minimum current in alternators used as motors, obtained by varying the exciting current (described last week), stated that the same thing was noticed by a workman at the station in the city of Cassel, Germany, who found that by adjusting the exciting current he could run the motors with 20 amperes instead of 30, which he naturally concluded was much better; in this installation he therefore always adjusted the field until he obtained the minimum current. Mr. Kapp, in investigating the subject, calculated the curve, which agreed to some extent with those given by Mr. Mordey, and shown in these columns last week. He obtained two curves, one with and one without the armature reaction. The curves are given in the Lond. "Electrician." Mr. Swinburne claims that the tests suggested by Mr. Mordey did not give the true efficiency of an alternator, as they did not take into account the tests for mechanical strength and the bearing behavior for full load; neither was the side pull of the belt included. He did not agree with Mr. Mordey as to the details of parallel running of alternators, as he claimed that not the dynamos alone, but the whole station, should be considered. He said it was very foolish to run a number of alternators in parallel from separate engines, each with its own independent speed governor. Mr. Crompton suggests doing away with separate governors and to put only one governor on the main steam pipe. He also claimed that the side pull of the belt should be considered in testing the efficiency of an alternator. Mr. Mordey in replying to all these speakers admitted that the conditions of a machine, run in this way, were not quite the same as when running entirely as a generator or motor, but he did not think the differences amounted to anything as far as the accuracy or the Foucault current were concerned or any practical conditions which the test was to determine. An experiment which he made indicated that the reaction of the armature on the field was not appreciable. He had never found the faintest difference in the field current when the whole of the armature current was thrown off suddenly. In reply to the statement that his method did not include the side pull of the belt he said that he was testing an alternator and not an engine, boiler or belt; the alternator might be direct driven, for instance. He did not think the side pull of the belt was a serious matter, and that a consequent reduction of the efficiency was due to the belt, and not to the bearing.

Synchronous Motors.—In discussing Mr Mordey's recent paper, abstracted in the Digest last week, Prof. Silvanus P. Thompson said that if they could run a motor without any load whatever, even without friction on the armature, they would, of course, require no current to drive it round; it ought to run without any effort. In that case the curve (see in Digest, April 1) which bends down, and comes to a minimum at some point above the zero line, would, of course, go down to zero. They would then have for the curve two straight lines meeting at a point. If the field magnets of a motor were excited exactly up to the proper point, its electromotive force would precisely balance in every instance the electromotive force coming in from the outside. The two waves were absolutely symmetrical, but opposed. But if it were not excited at exactly the right amount a machine running at its proper speed will give back an electromotive force not equal to the applied electromotive force; and then there would be a current, either leading or lagging in phase, according to whether the motor was under-excited or over-excited. If the magnetism of the motor field were at any moment proportional to the exciting number of amperes, then he presumed those two sides of the curve would be straight lines. But they knew the magnetism was not proportional. The only reason why it was nearly symmetrical was because near these lines the field was not excited to anywhere near what one called the saturation point of excitation.

Testing Dynamos.—In testing the dynamos of the Paddington station, London, the machines were run on a water resistance, made by hanging two metal plates in the neighboring canal, about 30 feet apart; the voltage dissipated was 1,000. This is about 30 volts per foot, and, therefore, two plates hanging in the water about a yard apart would light a 100-volt lamp attached to them.

Coupling Alternators.—Mr. Boucherot, in "L'Ind. Elec.," March 10, discusses a number of methods suggested by him, for coupling alternators by using condensers. In one method the condenser is connected in series, in another in multiple arc to the external circuit, and in a third there are three condensers and two transformers cross-connected, the whole being in parallel to the external circuit; in another, two poles of the machine are coupled together directly, while the other two are connected together through two resistances having induction, the junction of these resistances being connected to the other junction of the dynamos, through a condenser; in another, the arrangement is precisely similar to the latter, except that the two resistances are replaced by two condensers, and the condenser replaced by a coil having induction. The article, which does not involve much mathematics, although interesting, is of little use to practical engineers, as there are as yet no such condensers in the market.

Sparking at Commutators.—Mr. Weymouth concludes his long serial on this subject in the Lond. "Electrician," March 17. The article does not admit of being abstracted and must be read in its entirety.

Dynamo for Aluminium Production.—The Lond. "Electrician," March 17, gives an illustration and short description of the large dynamo for 7,500 amperes and 55 volts, for aluminium production at the Neuhausen works (Switzerland). The cut is a very poor one, and shows no detail. The shaft is vertical and is coupled directly to the turbine shaft. The commutator is below the armature, and the current is led off by 24 sets of brushes, there being five brushes to a set; all the brushes are moved simultaneously and are operated from the same point from which the throttle of the turbine is controlled. The magnet has 24 poles radiating inward; the total weight of the revolving part is 12 tons. The machine was built by the Oerlikon company.

TRANSMISSION OF POWER.

Transformers.—In order to reduce the core losses of transformers, Messrs. Siemens & Halske wind each coil into two equal sections, connecting them in parallel for half loads and in series for light loads, reducing the induction density to one-half and diminishing the core losses in the ratio of 5 to 2. In commenting on this, the Lond. "Electrician" calls attention to the fact that there is thereby an increase in the coil losses, and that therefore there is no saving until the output is less than half of full load, but that it would, if properly used, bring about an important increase in the all-day efficiency. In sub-stations such an arrangement is, of course, of little use.

INCANDESCENT LAMPS

High Efficiency Incandescent Lamps.—The Lond. "Elec. Rev." comments favorably on the article by Dr. Boehm, published in The Electrical World, Feb. 4, but claims that the author, like several others who have written on this subject, has failed to take into account the fact that although a lamp may be started at 2.5 watts per candle, the efficiency soon runs down most deplorably, and much faster than with lamps started at a low efficiency. It is of advantage to the public, therefore, to be supplied with lamps of comparatively low incandescence, while to the companies the reverse is the case.

TRANSMISSION OF POWER.

Motors in Mining.—A contributor to "The Science and Art of Mining," in comparing the three usual methods of underground hauling, finds that electricity is by far the cheapest for long distances; then comes wire rope and lastly compressed air; in regard to working cost, he finds that wire rope is cheapest for short distances, electricity comes next and then compressed air; for long distances electricity is again the cheapest. In his opinion the latter system is also perfectly reliable.

Electricity as a Motive Power.—Mr. Snell, in the Lond. "Electrician," March 17, begins a serial on this subject, intended apparently for non-electrical engineers. It is in the nature of a general review, but gives very little data. The present section gives a sort of general view of such a plant.

CENTRAL STATIONS.

Capacities.—"L'Ind. Elec." gives the following deductions concerning the central stations in London. For two districts covering residential rather than business quarters, the ratio of the maximum number of lamps to the total number installed, was in one case as 25 to 100, and in another as 27.8 to 100. For three stations, covering business districts, the ratios were 53, 50, and 58.5 to 100. The mean of all the London companies was as 40 to 100. The number of lights burning simultaneously, as compared with those which could have been run, was as 27.3 to 100. The total capacity of the central stations of London is 852,000 lamps of 8 c. p.; of this number 503,892, that is 59 per cent., are at present installed. For all the companies the number of lamps installed per mile of conductor is 1,100 lamps. This number is very variable with the different companies—for the St. James Pall Mall company it is 6,300; for the St. Pancras it is 4,360; for the Kensington and Knightsbridge company 3,700, and for the Metropolitan company 630.

Load Factor.—In an editorial, the Lond. "Electrician" states that there is a general impression among engineers of successful companies that an ordinary load factor runs up the cost of coal at least three times that of a supply where the load factor is unity.

Specifications.—Mr. Tomlinson begins a serial in the Lond. "Elec. Rev.," March 3, and continued in subsequent numbers, on "The Specification of Electric Plant and Mains for Open Competition," in which he discusses the methods in use and suggests modifications. It applied chiefly to the methods used in England.

Central Station for Burton-o-Trent.—Mr. Waring, in the Lond. "Elec. Eng.," March 17, describes the proposed municipal station, for 3,000 lamps of 16 c. p., using high tension alternating currents. The description is accompanied by large illustrations (though not giving much detail), showing plans and elevations; also a map of the district.

Paddington Central Station.—The description of this station is continued in the Lond. "Elec. Eng.," March 17.

The present issue includes illustrations of the engines, dynamos and conduits. A trial test with a false load showed a fuel consumption of 4.9 pounds of coal per kilowatt hour; the lowest result was 5.5 pounds.

WIRES AND WIRING.

Do ble Bronze Wire.—The wire mentioned in the Digest of March 25 is further described in the Lond. "Electrician," March 17, by the makers. It consists of an aluminium bronze core with a copper bronze envelope. It is said to have a low resistance, great tensile strength and quite an extraordinary toughness, as it will resist a larger number of bends than any bronze wire in existence. Its properties are given in a table. A No. 11 standard gauge wire, for instance, has a breaking strain of 857 pounds, an electrical resistance at 60 degrees F. of 4.43 ohms per mile and will stand from 8 to 10 bends of 180 degrees alternately through a radius of 5 millimetres. For a No. 20 wire these figures are 100 pounds, 69.60 ohms and 15 to 20 bends.

TELEGRAPHY.

Improved Single Needle Instruments.—A correspondent of the Lond. "Elec. Rev." describes an improvement which consists in placing iron cores in the coils of these instruments. The iron cores extend into the coils for about half their length, the rest of the space in the coils being taken up by the moving needle. It is stated that the speed of signaling is not lessened thereby, because the needle still moves quicker than the operators can read. The cost of this addition is a mere trifle, and is said to be not at all commensurate with the increased clearness of the signals or the saving in battery power.

ELECTRO-CHEMISTRY.

Antimony in Pure Copper.—According to the Lond. "Elec. Rev.," Mr. Hampe examined many commercial brands of electrolytic copper and finds that with 99.94 to 99.99 per cent. of copper there is from .007 to .02 per cent. of antimony; antimony seems invariably to be precipitated simultaneously with copper in copper electrolysis. He does not hold out much hope that this contamination with antimony will ever be eliminated in practice, but asserts that if the electrolysis is not pushed to the extreme limit, less antimony will be precipitated; the voltage and density of the current are not without influence.

Accumulators.—Dr. Lunge, in experimenting with pure and alloyed lead, finds that in cold solutions there is no difference between the actions of sulphuric acid on pure and on antimony lead when the antimony does not exceed .2 per cent.; when the acid is warm there is a difference in favor of pure lead. The action of nitrous sulphuric acid is stronger when air has access than when not, and is always stronger than that of sulphuric acid alone. A small percentage of copper to the lead does not increase its power to resist sulphuric acid when the temperature is below 200 degrees C.

Primary Batteries.—The Lond. "Elec. Rev" contains a well illustrated trade article on the present form of the Leclanche cells, as made by the English representatives of the Leclanche Company, of Paris.

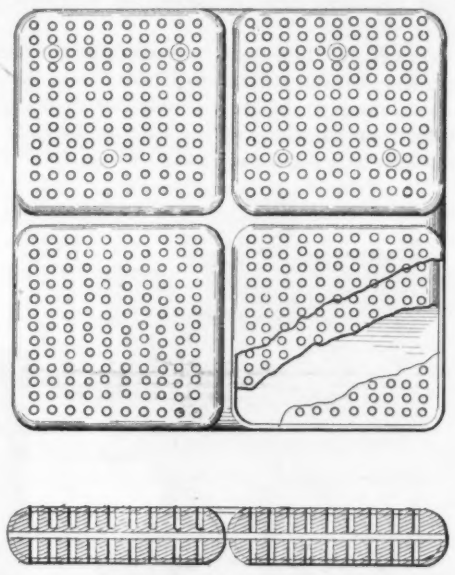
MISCELLANEOUS.

Electric Smelting and Casting.—The Lond. "Elec. Eng.," March 17, gives a short description of the Taussig system used in Bahrenfeld, Germany, of which the following is a full abstract: This system is claimed to produce 1,000 hundredweight of finished cast metal, such as bronze, iron, steel, copper, brass, zinc, platinum, gold or silver, free from pores or blow holes, every 15 minutes, with an expenditure of 360 hundredweight of coal. The fusion is effected by electricity in a furnace exhausted of air; the metal being run into molds, which are also exhausted, the vacuum being 92 per cent. For melting 30 pounds of iron in 15 minutes, 2,500 amperes and 2.5 volts were required; the current passes directly through the metal. Metallic electrodes are used, which, therefore, avoid contamination of the metal by carbon; oxidation and creation of air bubbles are avoided, and the refuse is reduced to a minimum; the metal becomes very liquid and, owing to the vacuum, extremely close and fine castings are made. Tests of the castings made by the German government have shown very satisfactory results. By using 30,000 amperes and 50 volts (about 2,000 h. p.) the casting form will have a length of 12 metres and a width of 1.5 metres, holding about 1½ tons; such castings could be produced in 15 minutes. The consumption of coal is said to be but 50 per cent. of that necessitated by the most perfect system in use at present; the use of water power would reduce the cost very materially. The furnace exhibited was 6×3×3 feet; two electrodes, apparently of wrought iron, are placed upright in the furnace; their surface is 8×4 inches. In this 30 pounds of pig iron were melted and cast in 14 minutes, including the exhaustion, which was carried to 92 per cent.; 2,500 to 3,000 amperes and 2 to 2.5 volts were required; fusion began in about eight minutes.

Action of Current on Fishes.—In testing an alternator by connecting it to two metal plates immersed in a canal, it was noticed that when fishes came within the influence of the current, they stiffened out and floated as if dead; from their length it was calculated they received from 5 to 10 volts; after floating down stream they were found to recover completely after about half an hour.

The Donaldson & Macrae Secondary Battery.

On March 21, 1893, a patent was granted to William W. Donaldson and Roderick Macrae, of Baltimore, Md., for certain new and useful improvements in battery plates. Messrs. Donaldson and Macrae are not, however, new workers in this field; in fact, they were among the



FIGS. 1 AND 2.—DONALDSON & MACRAE BATTERY.

earliest in this country to take up the secondary battery and apply it to commercial work. In 1883 they established at Baltimore the first distributing storage station in the United States, and a year later a second plant was installed. For several years after this they were identified with the application of storage batteries to practical work, especially for traction purposes, and in 1891 the Donaldson-Macrae Electric Company, of Baltimore, was incorporated.

The aim in this battery has been to secure a plate in which the inactive material employed will not be forced away from the active material so as to cause bulging or breakage of the plate, and produce a plate made up of a series of small plates sweated or otherwise connected together so as to produce finally a plate of any desired dimensions.

To attain this end they construct a battery plate by the employment of a diaphragm, upon which is mounted a cup-like section. Between this diaphragm and the section is contained the active material which together with the section is perforated to give access to the active material of the exciting liquid employed. A section may be applied to each side of the part designated as a diaphragm, and then several of these sectional plates united to each other in any suitable manner to constitute a battery plate in which the active material is confined by reduced portions of inactive material, whereby the latter possesses sufficient strength even when the material is very thin to prevent buckling, bulging or breaking. Thus the proportionate weight and expense of the inactive to that of the active material in a plate are reduced, with the resulting advantage of increased capacity in proportion to weight.

The accompanying illustration, Fig 1, gives a side view of a complete plate with the diaphragms sweated together, with portions broken away. Fig. 2 shows a cross section of the plate. In building up a battery the sections may be placed side by side, as shown in Fig. 1, or arranged in other forms in any shape desired. They may be united by solder or by sweating the edges of the arranged in other forms, in any shape desired. They be united by solder, or by sweating the edges of the diaphragms. When a number of plates are built up a spacing block of insulating material is used which gives excellent satisfaction. The whole cell is compact, efficient, and is claimed to be practically indestructible.

The Cooper High-Speed Engine.

The great demand for high class engines created by electrical development has had a most beneficial effect in stimulating the inventive and mechanical faculties of steam engineers, and the resulting advances in this branch in late years have been very marked. We illustrate an engine just put on the market by Cooper, Roberts & Co., of Mount Vernon, O., in which evidence of skillful design is apparent and that contains several new features.

The engine is of the over-hanging cylinder, self-contained type, with centre crank and over-hanging wheels. Great attention has been paid to the design of the frame, which is a combination of the straight line and girder types. It is exceptionally strong and rigid, having a broad, flanged base and internal ribs, and shaped so as to inclose the working parts.

All of the bearings are exceptionally large and "genuine" babbitt is used throughout for babbitting. The shaft is of forged steel with cast-iron counter-balancing discs shrunk on, and has the same diameter as the crank pin or one-half the diameter of the cylinder.

The cross head is of a new and modern design, having phosphor bronze shoes whose length is equal to the stroke of the engine, the width being one-half the length.

The valve is of the hollow piston type, with self-expanding rings, making it perfectly steam tight. This type of valve insures lasting service, prevents loss from leakage, and its being perfectly balanced under all circumstances allows the governor to be extremely sensitive and maintain close regulation.

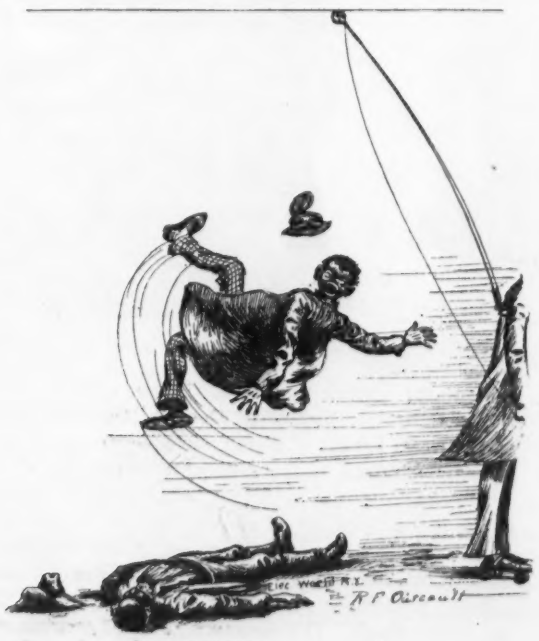
The shaft governor (Haine's patent) has a parallel movement across the shaft instead of a pendulum movement. One arm of the eccentric is connected by a link to the arm of the wheel, and the other arm by a lever mechanism, by which the eccentric has its centre moved nearer to or further from the centre of the shaft, but always in a straight line, maintaining a constant lead or admission at all points of the cut-off, and thus obviating possibility of the engines racing.

The adjustable weights are such as to practically counterbalance the weight of the eccentric, which prevents disturbance of the proper circular path through which the eccentric rotates.

When the eccentric is at its points of greatest travel and most rapid motion, the links and levers are at right angles to its arms to which they are connected, so that the increased thrust of the eccentric falls upon the links and levers, and thus prevents the springs from being put to an unequal tension and steadies the connected

Say Sam, what fool riggin' you got fastened to youh back?

You crazy nigger—can't you see? dis yeah is my new patent trolley—all you have to do is to let the trolley touch the wire and. away * * * * * * * * * * you goes.



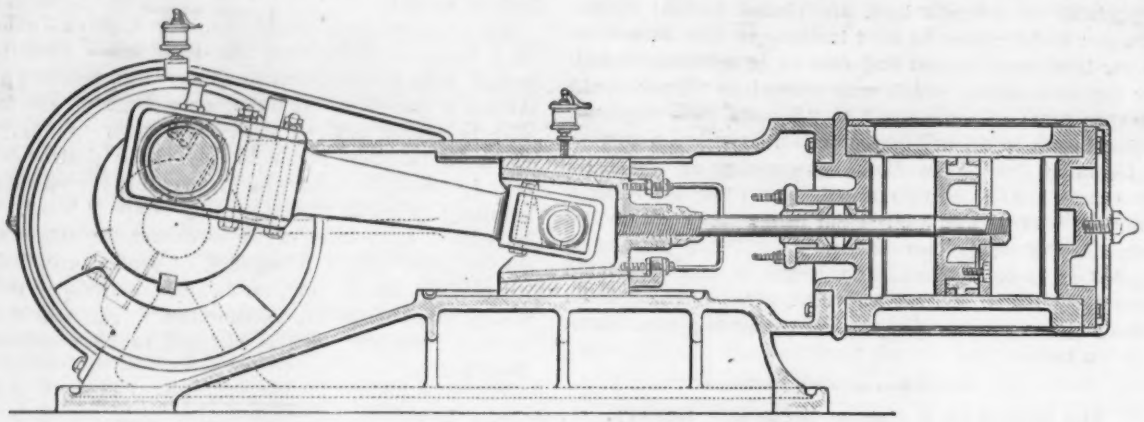
A SUGGESTION TO NEW YORK'S RAPID TRANSIT COMMISSION.

parts. The levers are of the same power, and combine on one pivot, one on each side of the arm of the wheel.

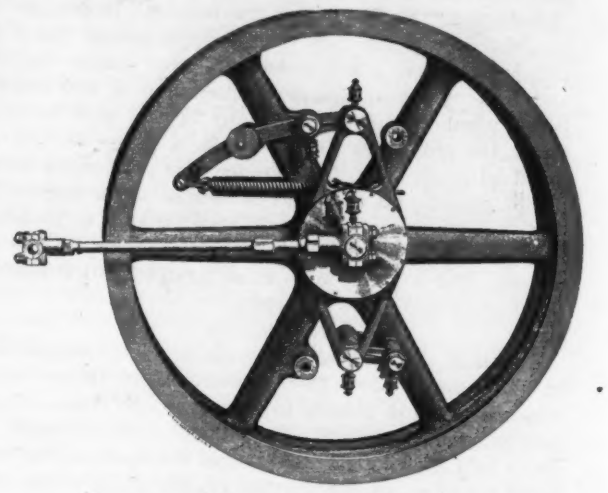
The spiral springs are attached to one end of the levers by means of a switching link and the other ends are hooked in an eyebolt passing through an opening in the head of a swivel bolt pivoted through a boss on the wheel, which is engaged by a nut on the opposite side of the boss.

This arrangement of the springs permits the swivel bolt to adjust itself, and allows the springs to move outward in a straight line without the buckling caused by centrifugal force.

The eccentric is of a new design, without straps, thus making it free from friction.



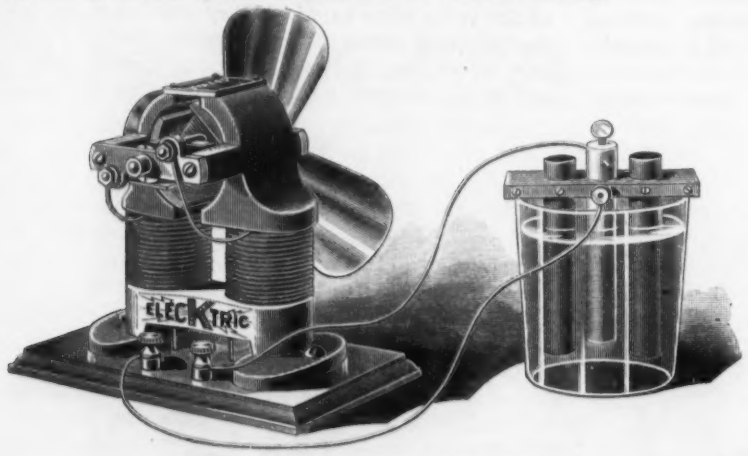
COOPER HIGH-SPEED ENGINE—SECTIONAL VIEW.



GOVERNOR OF COOPER ENGINE.

The Knapp Electric Motor No. 1.

This motor, manufactured by the Knapp Electric and Novelty Company, 34 Warren street, New York City, is of the same design and finish as the larger sized motors produced by the same company, and is claimed to develop greater power from the same source than any other motor of its size. It is fitted with a pulley to run toys and small machinery and mounted on a mahogany base. It is operated by a carbon and zinc battery which may be contained in a tumbler, as shown in the accompanying illustration, the carbons and zinc being ½ inch in diameter. The speed of the motor is about 2,500 revolutions per minute, and it will run from one to two hours on one charge of the battery. The complete outfit comprises a plant that weighs less than 2½ pounds.



THE KNAPP ELECTRIC MOTOR.

Electric Heater for Street Railways.

That the advantages of electric heaters for electric street railways are being recognized is apparent from the number and character of firms embarking in their manufacture. One of the latest in this field is the well known Consolidated Car Heating Company, of Albany, N. Y., whose apparatus we illustrate below:

In the construction of the C. C. H. Co.'s electric heater the resistance wire is divided into a number of parts so that these may be assembled in different combinations, offering different resistances to the passage of current, so as to obtain different intensities of heat. The resistance wire on each car is usually divided into twelve equal parts, two of these being combined into one heater, so that six heaters are placed in each car, three on each side. A cylindrical glazed porcelain insulator is provided, mounted upon a five-eighths inch square iron rod; a spiral groove is formed upon the surface of this, extending continuously from one end of the heater to the other, and in this spiral groove the resistance wire is wound (See Fig. 2.) At the end of each division a glazed porcelain plate is provided in which binding screws are placed, to which the ends of the spiral are connected. The two parts of the resistance wire placed in each double heater are separated by a glazed porcelain plate, so that they may be connected independently where the plan of wiring so requires.

The porcelain insulator is supported by the iron rod above mentioned, which is carried at the ends of the heater upon two cast iron supports. By these supports the heater is fastened to the floor of the car, which also furnish the means of securely attaching the covering box, below described, of the heater itself.

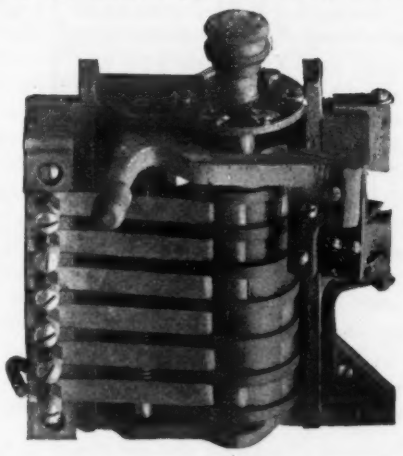
The heater is covered with a wooden box, which is lined throughout with asbestos mill board, in which is made a screened opening through which the circulation of air from the heater is maintained. Its appearance when thus completed is quite ornamental. The covering box may be made in wood of any desired kind and finish.

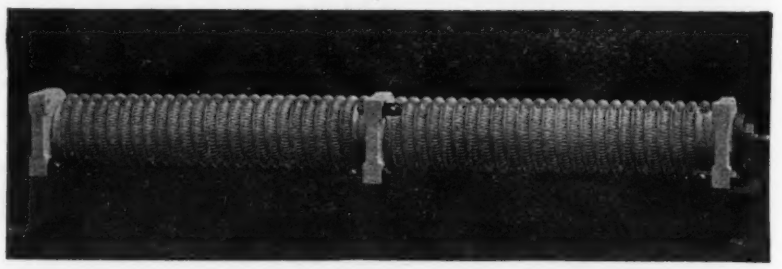
Six electric heaters are placed in each car, three being located on each side under the seat, and warm the car by indirect radiation. The air flowing in at the bottom of the heater comes in contact with the heated wire spirals and with the porcelain insulators, then flows up through the casing and out at the grated opening at the front of the heater. This warmed air from the six heaters produces a most agreeable temperature in all parts of the car.

The electric switch, Fig. 1, has six different positions. In one position the circuit is open (no heat) and the remaining five positions give different intensities or grades of heat. Different combinations of the electric heaters are made by the different positions of the switch, so as to increase or decrease the flow of current to correspond with the increase or decrease in the intensity of heat required.

To prevent sparking across the face of the cylinder in moving the switch from one position to another, one combination is broken before the next one is made.

The range of current employed is from 2 to 12 amperes on a 500-volt circuit, the largest current only being necessary in zero weather.





FIGS. 1 AND 2.—CONSOLIDATED CAR HEATING COMPANY'S ELECTRIC HEATERS.

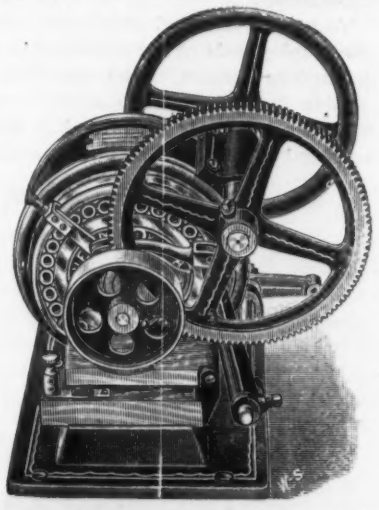
New Meston Motor Outfits.

The accompanying illustrations show two recent adaptations of the ⅛-h. p. Meston alternating current motors for power purposes. These motors are manufactured by the Emerson Electric Manufacturing Company, of St. Louis, of which the Electric Appliance Company, of Chicago, is the general Western agent.

The single motor is geared with a small rawhide pinion to a countershaft as shown, with a proportion of one to nine, giving a maximum speed of 280 revolutions per minute on the countershaft, which in many cases is decidedly preferable to belting from a speed of 2,500 on the motor shaft. The countershaft and gearing are carefully designed to transmit the power with the least possible friction, and the motors have been found to be more effective for power in this way than belted direct. This single outfit is provided either with the regular hand regulator, by which the speed can be varied or direction reversed at will, or with a foot regulator for accomplishing the same result, or with a foot regulator and brake by which the speed can be varied at will, the direction of revolution reversed or the motor stopped instantly.

The duplex outfit consists of two ⅛-h. p. motors coupled to a single countershaft giving double the power of a single motor. They are supplied with a single and independent regulator for each motor or with a connected hand regulator and brake which regulates or reverses both motors at once and applies the brake to both motors, but are not furnished with a foot regulator. These outfits promise to find a large field where small power motors are wanted on alternating circuits. The motors used are the regular Meston fan motors which have been on the market for three years, and have the reputation of giving absolute satisfaction wherever used.

The Emerson Electric Manufacturing Company, the manufacturers of the Meston outfits, also have a new alternating dental outfit about ready for the market. The Electric Appliance Company, of Chicago, are the general Western agents for the Meston fan motors and outfits.



NEW MESTON MOTOR OUTFITS.

The Eureka Oil Purifier.

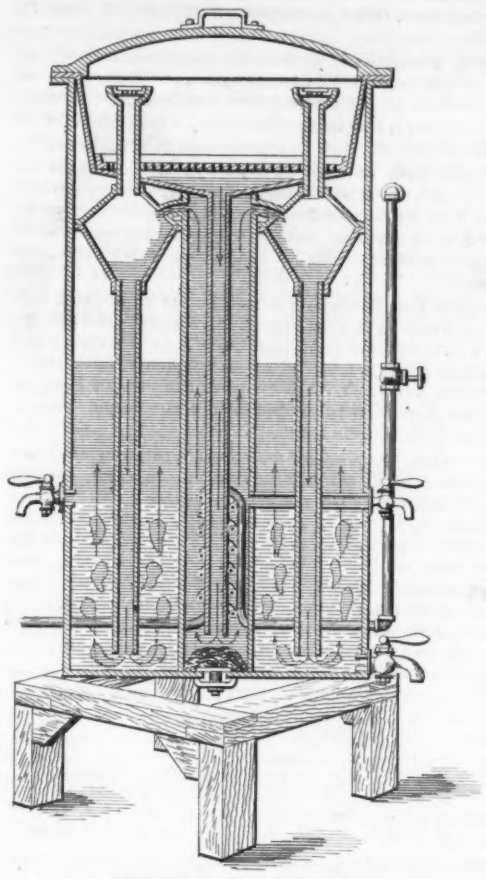
No effort has been spared by the Eureka Oil Purifier Company, 324 and 326 Fairmount avenue, Philadelphia, Pa., to produce a thoroughly reliable oil purifier, and the result of its effects is shown in the accompanying illustration, which gives a sectional view of the Eureka purifier. It is a filter and purifier combined, but, notwithstanding this, it is exceedingly simple in construction. It is made of the best material, and is very durable.

The body of the purifier consists of a plain tank which is constructed of the best rolled galvanized iron, nicely japanned exteriorly, and finished with handsome burnished brass trimmings. In the top of the purifier is a hopper, into which waste oil is thrown, and this has a strainer in the bottom, which collects the coarsest of the waste material, while extending from the bottom is a pipe, which leads vertically downward nearly to the tank bottom, and this pipe is surrounded by the central heating well, which extends from the bottom of the tank to the hopper. It is in this well that the coarser particles

of sediment are collected, and in the bottom of the well is a removable plug, which is arranged in the tank bottom, and which enables the well to be quickly and thoroughly cleaned out. A steam pipe extends into the well from one side of the tank, is formed into a steam coil which encircles the pipe, and finally passes out, as shown in the figure.

At the top of the well and on opposite sides are vents, through which the oil passes from the well, and the oil runs into two little hoppers, which are arranged on opposite sides of the well, and these have outlet pipes which extend downward to a point near the bottom of the tank and deliver into the water in the tank bottom which washes the oil.

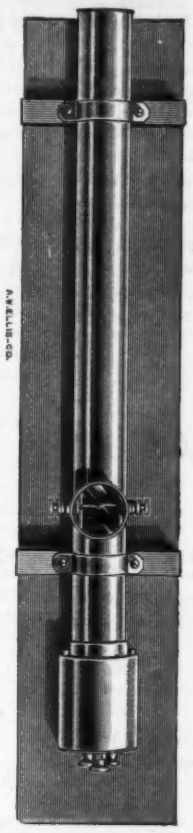
The tank forms only one continuous chamber around the well, and the hoppers and their pipes are supported by braces, which form no obstruction to the oil. The lower portion of the tank is filled with water, and a faucet opens from the tank at a point opposite the water line; and by leaving this faucet open when the water is poured into the tank, the proper water line may be quickly located. A similar faucet is arranged on the opposite side of the tank and connects by a pipe with the well. This faucet is opened when the well is cleaned to tap the oil down to the faucet line, then the hand hole is opened so the well can be emptied of the refuse. On the side of the tank, near the bottom, is an ordinary water gauge, and the tank has also, higher up, an oil gauge, which is like the ordinary water gauge, and which shows the height of oil, while near this, and also on the outside of the tank, is a drawpipe, which connects at different points with the upper portion of the tank by means of valves, and the drawpipe has a faucet at the bottom, through which the oil may be drawn.



EUREKA OIL PURIFIER.

Railway Motor for Narrow-Gauge Tracks.

The needs of the narrow gauge railway have as yet escaped the close attention of the electrical companies. The General Electric Company, however, has recently designed and placed on the market a new type of single reduction motor, shown in the accompanying cut, designed especially for use on tramways and other places where a narrow wheel gauge is desired. In general principle of design this motor closely resembles the standard W. P. type, with the exception that it has four poles, the two salient ones of which are at top and bottom, and the two consequent poles at the side of the frame. The armature, field spools, commutator, brushes and all the trimmings of the motor are entirely inclosed by the frame, and the armature bearings are so designed as to allow of only a bare clearance between the wheel of the truck and the sides of the motor. These motors are wound for either 200 or 250 volts, and are rated at about 250 pounds horizontal effort on a 20-inch wheel. The extreme outside width is only about 15¼ inches, so that the motor may be used on a road of but 18-inch gauge. The total weight of the motor with gear and gear case complete is about 680 pounds.

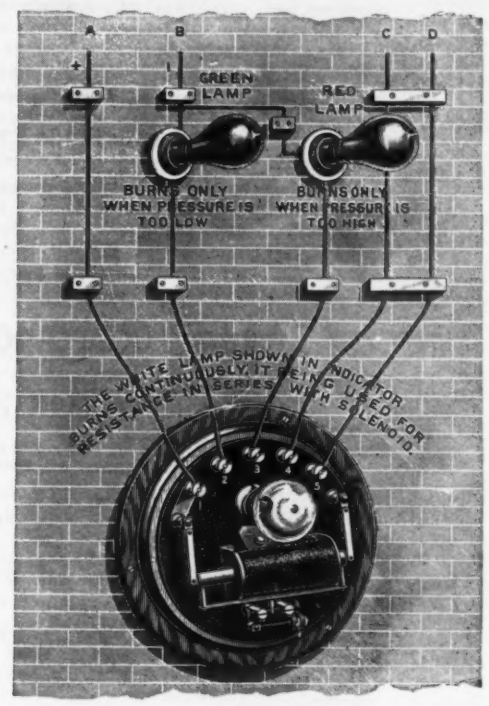


RAILWAY MOTOR FOR NARROW-GAUGE TRACKS.

The Holtzer-Cabot Electric Company's Current Indicator and Controller.

The Holtzer-Cabot Electric Company, 92 Franklin street, Boston, Mass., is about to place upon the market current indicators and controllers adapted to both alternating and direct systems.

Fig. 1 shows the indicator, which may be adapted to both alternating or direct currents, and which is built on the principle of the Cardew voltmeter, a most sensitive and accurate instrument. This indicator is not influenced by shocks or vibrations, and has no temperature error.

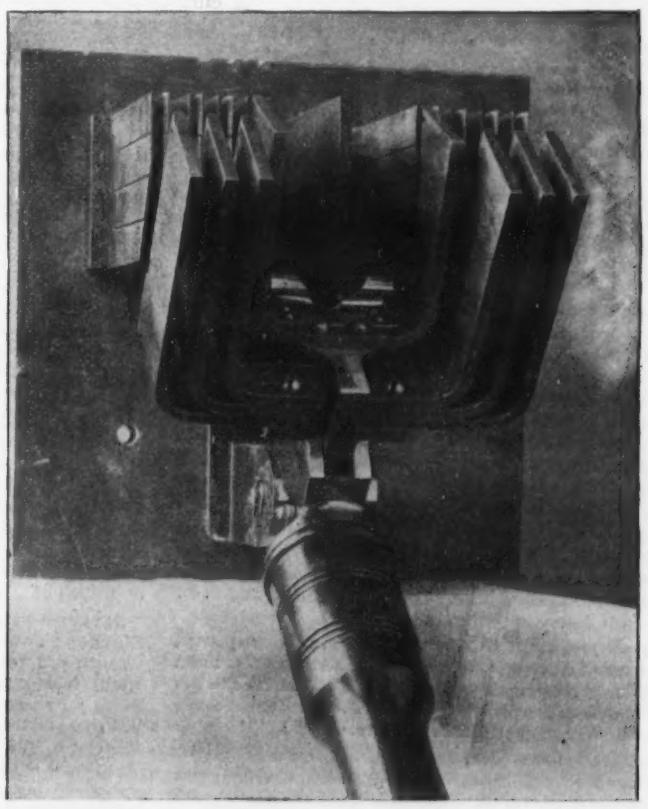

A
B
C
D
+
GREEN LAMP
RED LAMP
BURNS ONLY WHEN PRESSURE IS TOO LOW
BURNS ONLY WHEN PRESSURE IS TOO HIGH
THE WHITE LAMP SHOWN IN INDICATOR BURNS CONTINUOUSLY, IT BEING USED FOR RESISTANCE IN SERIES WITH SOLENOID.

FIGS 1, 2 AND 3.-HOLTZER-CABOT ELECTRIC COMPANY'S CURRENT INDICATOR AND CONTROLLER.

In Fig. 2 is shown the solenoid indicator applicable to direct currents, many of which have already been in use for two years. This type is adapted to power circuits, or where extremely close indication or regulation is not important. Both of these instruments may be used as voltmeters, lighting a red lamp when the voltage is too high, a blue one when the voltage is too low, and a white one when it is normal. Both are also used to actuate the regulator, shown in Fig. 3, which is connected with the dynamo rheostat, and which may be run by a small motor or from shafting.

A 3,000 Ampere Ajax Switch.

Probably the largest snap switch ever manufactured is that for the switchboard of the Calumet Electric Street Railway Company, of Chicago. This company on Dec. 31, 1892, ordered from the Detroit Electrical Works eight 100 kw. multipolar generators and a switchboard for 10 generators of that capacity, and eight feeders, for the electrical equipment of its new power station. The switchboard will be of white marble, and is designed to be the handsomest and most complete railway switchboard yet installed. The switchboard will be equipped with the Detroit Electrical Works' ammeters and line switches, Weston voltmeters and Ajax switches. Each generator will have a separate section equipped with ammeter and line switch, high and low potential, 'bus switch, and Ajax triple-pole switch with fuses and hand regulator. Each feeder will have a separate section which will be equipped with ammeter, line switch, high and low potentials, 'bus switch, single pole, double break Ajax feeder switch and Wasson station lightning arresters. In the centre of the board will be a main section upon which will be mounted one 3,000-ampere meter, a potential switch for connecting voltmeter to any generator or 'bus bar, and a 3,000-ampere single pole double break Ajax switch.



A 3,000-AMPERE AJAX SWITCH.

AFFAIRS OF THE COMPANIES.

The Brush Electric Company, of Cleveland, O., at the annual meeting of its stockholders held on Tuesday, March 21, 1893, elected the following officers: W. H. Lawrence, president; John S. Bartlett, first vice-president; C. A. Coffin, second vice-president; S. M. Hamill, secretary; W. B. Bolton, general counsel: B. F. Miles, treasurer; S. M. Hamill, general manager; A. H. Hough, assistant treasurer; L. B. Le Vake, assistant secretary J. F. Hughes, auditor.

Edison Illuminating Stock Increased.—At a meeting of the stockholders of the Edison Electric Illuminating Company held recently, the capital stock of the company was increased from $6 500,000 to $10,000,000. The increase was made in order to take up the convertible bonds as they may be presented. The rest of the new stock will be used in construction. The new by-laws of the company were ratified at this meeting. They had been drawn to conform with the statutory requirements.

The Shawhan-Thresher Electric Company, of Dayton O., has been organized, with J. F. Shawhan and A. A. Thresher as partners. The company will carry on a business of manufacturing motors, dynamos and electrical apparatus, including street railway motors and electrical specialties. It has a shop equipped with all the modern machinery for turning out first-class work. One of its 110-light dynamos has just been sold to the Gem City Shirt Factory, Dayton, O., and other orders are under way.

The Short Electric Railway Company, of Cleveland, O., at the annual meeting of the stockholders held at its offices on Wednesday, March 22, 1893, elected the following officers and directors: President, B. F. Miles; vice-president, S. H. Short; general counsel, W. B. Bolton; general manager, S. M. Hamill; directors, S. H. Short, W. H. Lawrence, M. T. Herrick, B. F. Miles, James Parmelee, W. B. Bolton and S. M. Hamill. Hereafter the Short Electric Company will be more closely associated with the Brush Electric Company. In the past they have had two sets of officers, two separate general offices, with a full corps of office clerks and two sets of district offices and agencies. Mr. Sidney H. Short is still vice-president and electrician of the company. Mr. S. M. Hamill is general manager of the Brush Electric Company. The Short company looks forward to doing a large business with its new gearless motor.

NEW INCORPORATIONS.

The Kimball Electric Company, Chicago, Ill., capital stock, $5,000,000, has been formed to construct street and other railways, etc. A. L. Allen, W. R. Payne, are C. H. Tallmadge are the promoters.

The Electrical Association, Portland, Me., capital stock $500,000, has been formed to own, equip and operate electric plants. Chas. H. Newhall, Jno. S. Bartlett and M. P. Clough, Ly Mass., are the promoters.

The Mutual Light Company, Alliance, O., capital stock $150,000, has been formed to operate an electric light plant and gas works. W. W. Cantine, Elisha Teeters, Wm. Stallcup, W. C. Ailes and S. Shimp are the promoters.

The Jackson Light and Power Company, Jackson, Mich., capital stock $100,000, has been formed to generate and furnish electric light, power and heat, etc. W. A. Foote, A. N. Foote and J. B. Foote, all of Jackson, are the promoters.

The Muscatine Electric Railway Company, Oskaloosa, Ia., capital stock $300,000, has been formed to purchase and operate railway, light and power plants. The promoters are C. Winter, W. H. Seevers, G. W. Seevers, C. E. Lofland and W. H. Hawkins, of that city.

The Madera Electric Light Company, Madera, Cal., capital stock $100,000, has been incorporated to build and construct an electric light plant. D. Tombien, Oakland; Sol. Lazar, R. L. Hargrove, A. B. Zangard and J. E. Newman, all of Madera, Cal., are the promoters.

The Southwestern Railway Company, St. Louis, Mo., capital stock $3,000, has been formed to build and operate a street railway and to furnish electricity. D. G. Hamilton, Chicago; Christian Peper, Robt. McCulloch, and S. P. Galt, St. Louis, are the incorporators.

The Parkersburg Gas and Electric Company, Parkersburg, W. Va., capital stock $500,000, has been formed to produce gas and electricity for all purposes. J. V. Rathbone, C. H. Shattuck, C. H. Turner and C. S. Despard, all of Parkersburg, W. Va., are the promoters.

The Heat, Light and Power Company of New Jersey, Trenton, N. J., capital stock $200,000, has been formed to manufacture and sell gas and electrical supplies, etc. The promoters are J. H. Scudder, E. V. Richards, D. Mackenzie, J. W. Lanning and W. H. Apgar, all of Trenton.

The Mount Vernon Electric Railway and Light Company, Mt. Vernon, O., capital stock $400,000, has been formed to construct and operate electric railways and to furnish light, heat and power. P. B. Chase, Howard Harper, Wm. Bird, Jr.; Jas. Israel and B. L. McElroy are interested.

The Phœnixville Electric Street Railway Company, Phœnixville, Pa., capital stock $50,000, has been formed to construct and operate an electric railway. Francis Fenimore, St. Davids; L. Knowles Perot, Philadelphia, and Rich. W. Davids, Lower Merion, Pa., are the interested parties.

The Kennett Electric Light, Heat and Power Company, Kennett Square, Pa., capital stock $20,000, has been formed to furnish light, heat and power by electricity. W. W. Gawthrop, J. Monroe Palmer, H. H. Gawthrop, D. W. Hutchinson and J. E. Worrall, of Kennett Square, are the organizers.

The Florence Rapid Transit and Power Company, Florence, Col., capital stock $100,000, has been incorporated to build and equip an electric railroad from Florence to various other towns. Jas. A. McCandless, H. C. Topping, J. M. Hanks, Isaac Canfield and J. W. Work are the incorporators.

The Bound Brook Electric Light, Heat and Power Company, Bound Brook, N. J., capital stock $5,000, has been formed to generate electricity for light, heat and power. Chas. P. Sebring, North Plainfield; Louis J. Auerbacher, Newark, and Fred H. Cook, Bound Brook, N. J., are the promoters.

The Powelton Avenue & Thirty-fourth Street Passenger Railway Company, Philadelphia, Pa., capital stock $20,000, has been formed to construct and operate an electric railway. G. A. Aldrich, Audubon, N. J.; John F. Keaton, Germantown, and J. S. Freeman, Wayne, Pa., are the incorporators.

American Armature Company, Portland, Me., capital stock $50,000, has been incorporated to manufacture and deal in armatures, transformers, electrical devices and supplies. The organizers are F. J. Cushing, T. J. Ready, Lynn; Edwin Sawtell, Brockton, Mass., and Benj. Thompson, Portland, Me.

The Bessemer Contract Company, Jersey City, N. J., capital stock $10,000, has been incorporated to purchase, lease, rent, construct and maintain water-works, gas-works, electric light and power plants, etc. The promoters are E. A. Hopkins, Philadelphia, Pa.; J. M. Howard and F. P. Hoffman, New York City.

The Humboldt Electric Light and Power Company, Eureka, Cal., capital stock $50,000, has been formed to manufacture and sell electricity, and to do a general electrical business. J. Armstrong, San Francisco; Josiah Bell, S. A. Vance, J. M. Melendez and Wm. V. Cockwood, of Eureka, are the promoters.

The Automatic Telephone and Electric Company of Illinois, Chicago, Ill., capital stock $250,000, has been formed to construct and operate a telephone, signal and electric systems, and manufacture apparatus for use of same, etc. J. Russell Griffiths, Victor C. Sanborn and Sidney Coolidge are the promoters.

The Pittston Suburban Passenger Railway Company, of Pittston, Pa., capital stock $90,000, has been formed to construct and operate an electric railway in Luzerne county. John T. Lenahan, Wilkes-Barre, Pa.; Patrick F. Joyce, Pittston, Pa., and Louis A. Watrous, Scranton, Pa., are the organizers.

The Consolidated Electric Company, Greenwich, N. Y., capital stock $35,000, has been formed by the consolidation of Greenwich Electric Light and Power Company with Cambridge Electric Light and Power Company. Henry Gray, Le Roy Thompson and John Larake, Greenwich, N. Y., are the incorporators.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, April 1, 1893.

Mr. N. L. Schloss has resigned his position as salesman for the Stilwell-Bierce & Smith-Vaile Company, 112 Liberty street, New York City.

Mr. H. P. Barr, secretary and general manager of the Sperry Electric Railway Company, 29 Broadway, New York City, has resigned his position with that company.

The Eddy Electric Manufacturing Company, of Windsor, Conn., has removed its New York offices from 136 Liberty street to the Havemeyer Building, Cortlandt, Dey and Church streets.

The Eppinger and Russell Creosoting Works, of which Mr. Geo. S. Valentine is manager, have removed their New York office from 160 Water street to the Morris Building, corner Broadway and Beaver street.

Mr. John M. Duncan has resigned his position as manager of the New York office of the Stilwell-Bierce & Smith-Vaile Company at 112 Liberty street, this city. His successor is Mr. Joseph B. See, who has been connected with the company for many years in another capacity and has shown by his work that he well deserves the promotion.

The Western Union Telegraph Company.—The following promotions and changes have recently taken place in this company: W. J. Dealy, formerly manager of the operating department, has assumed the position of superintendent of the commercial news department; Mr. Albert E. Sink, formerly night manager, has taken Mr. Dealy's former place, and Mr. Edward F. Cummings the position lately held by Mr. Sink. Gen. Thos. T. Eckert, who succeeded Dr. Norvin Green as president, will combine his former duties of general manager with those of president.

Mr. R. N. King, president of the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., who has been spending a few days in New York on business, returned to Dayton on Sunday. Mr. King says that business with the consolidated company has been so active that it has been found very difficult to keep up with it. By increasing the facilities, however, it is hoped now to be able to handle all orders promptly.

Albany, April 1, 1893.

Several of the leading capitalists of Northern New York are contemplating the formation of a stock company to furnish electric light for Glens Falls, Sandy Hill, Fort Edward, Saratoga and Lake George. The power is to be furnished by the damming of the Hudson River near Glens Falls. The several companies now existing will be consolidated.

The Edison Electric Illuminating Company of Brooklyn, has filed with the Secretary of State a certificate showing that it has increased its capital from $1,500,000 to $2,500,000. The increase is for the purpose of extending the business of the company. The amount of the capital actually paid in is $1,500,000, and the liabilities of the company amount to $593,500, including a bonded indebtedness of $500,000.

The Coney Island & Gravesend Railway Company, capital $350,000, has been incorporated with the Secretary of State. The company will operate a street surface railroad for a distance of four miles over the streets of Coney Island and Gravesend. The directors are: George W. Roderick, Sheepshead Bay; S. S. Williamson, H. R. Williams, Gravesend; Michael J. Dady, Ernest H. Davis, John Durren, Brooklyn; C. Stubenford, Fred E. Bader, F. G. Gallagher, Coney Island.

The Senate Railroad Committee has given a hearing on Mr. Quigley's bill making ten hours a day's work on street surface and elevated railroads. Charles J. Bissell for the street railway association, including forty roads, argued against the bill on the ground that it was unconstitutional. The Hon. Hamilton Harris, of Albany, for the Albany railway, said that if the measure passed and an employé should work five minutes overtime both he and the road would be guilty of a misdemeanor. Senator McCarren favored the bill.

A certificate of consolidation of the Greenwich Electric Light and Power Company and the Cambridge Light and Power Company, forming the consolidated Electric Company of Greenwich, Washington county, has been filed with the Secretary of State. The capital of the new company is $35,000, and the directors are: Henry Gray, Le Roy Thompson, James Lavake, John Brooks, Mortimer Teffts, Harry C. Grey, Greenwich; Jerome B. Rice, Andrew B. McNish and John L. Agan, of Cambridge. The company's operations will be carried on in the towns of White Creek, Jackson, Easton and Greenwich, Washington county, and the town of Schuylerville, Saratoga County.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., April 1, 1893.

The Pettingell-Andrews Company, Boston, Mass., has declared a dividend of one per cent., payable April 1, 1893.

The Stirling Company is now placing in position its exhibit in the main boiler room of Machinery Hall, and has just closed another contract for two additional of 250 h. p. each to be placed in the annex.

Mr. W. L. Puffer read a paper recently before the Society of Arts on the action of compound dynamos when run in parallel, and seldom has the subject received such exhaustive attention as was the case in this instance, and it was much appreciated by those in attendance.

Wilkinson & Tinkham, of Boston, manufacturers of the W. & T. lock, are meeting with success with this lock, which, as they claim, is the most perfect electric lock yet invented; it never leaves the door unlocked, it is impossible to shake or force the door open and is reversible.

The Clyde Electric Motor Company, 147 Charles street, Providence, R. I., has perfected its motor. This motor is simple in construction, very light and efficient and is particularly applicable to fan and sewing machine work or where power is required for running light machinery. Mr. R. F. Capwell is treasurer and general manager.

Rapid Transit for Boston.—A meeting of capitalists consisting of George Ames, S. E. Peabody, H. M. Whitney, H. D. Hyde, J. Q. Adams, C. A. Coffin and H. L. Higginson met recently to discuss the solution of this much talked of question, and as a result Messrs. Higginson, Ames and Whitney were appointed a committee to formulate a plan to be presented before the Rapid Transit Committee of the legislature.

Change of Name.—The Porter & Leavitt Electric Motor Company, of Providence, R. I., will in future be known as the Leavitt Electric Motor Company, with factory and office at 124 Mitchell street, Providence, R. I. Mr. B. F. Leavitt, who started this business a few years ago in a small way, is to be complimented on his success. The shop is thoroughly equipped with the necessary machinery and tools for handling the work conveniently. Up to this time the company has always been crowded with orders, many of which would have been canceled owing to the fact that the company has not had the facilities to handle such a volume of trade, had not the plant been enlarged.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, April 1, 1893.

A. D. Adams, of the Commercial Electric Company, Indianapolis, has been in Chicago for some days during the past week.

Mr. G. Van Ginkel, of the Brazil (Ind.) Rapid Transit Street Railway Company, was in Chicago for two or three days during the past week.

Gen. C. H. Barney, superintendent of the Electric Launch and Navigation Company, returned to Chicago one day last week and at once commenced his arrangements for the carrying out of his World's Fair contract.

The Electric Launch and Navigation Company received a telegram on Saturday last from Detroit, Mich., saying that twelve of the boats for the World's Fair contract were loaded on cars and shipped that day. General Barney has the storage batteries at the park and will soon commence the equipment of the boats.

The Commercial Electric Company, of Indianapolis, has appointed the following agents during the past week: Commercial Electric Company, Detroit, Geo. Fisher, manager, parts of Michigan, Indiana and Ohio; Bissell & Dodge, Toledo, Ohio, the remainder of the same States. This company is doing a very satisfactory business, with excellent prospects for the coming year.

The Electric Appliance Company, of Chicago, has closed arrangements to represent Diehl & Co. in the West, handling a full line of their ceiling and exhaust fans for direct, incandescent, street railway or arc circuits. The Diehl fans have been well and favorably known for a number of years, and the Diehl company claims to control the primary patents on a self-contained ceiling fan; that is, each ceiling fan having its own individual motor.

The Columbian Metallic Rod-Packing Company has opened an office No. 360 The Rookery, Chicago. The office is in charge of Mr. W. E. Maher, who is well known among railroad men. At the recent meeting of the Electric Light Association, Mr. Maher was present in the interest of the company. The Columbian Metallic packing is of recent date, as the patents were issued March 8, 1892. The company has made rapid strides and is doing a large business. The packing is of great use on high-speed electric light engines and is claimed to be the only metallic packing that can be used on the rotary valves of Corliss engines.

Detroit, Mich., April 1.

J. C. Hubner, agent of the Westinghouse Electric and Manufacturing Company, is on a business trip in Toledo this week.

The Electrical Construction Company, of Detroit, Mich., has removed its office from Rowland street to 192 Griswold street.

J. S. Crook & Co., of Detroit, Mich., contractors and dealers in electrical supplies, have removed their office and storerooms to 174 Griswold street.

Chas. Tamblyn, of the Turbayne-Tamblyn Electrical Company, of Detroit, Mich., has gone to Cleveland and other Ohio towns this week on a business trip.

Hurd, Liggett & Cooper, Detroit, Mich., have opened an office and repair shop at 212 Griswold street, as electricians and machinists for electrical construction, repairs and experimental work.

The Detroit Motor Company, Detroit, Mich., is still busy in its factory, especially in the motor department. It has recently shipped a 300-light dynamo to the Novelty Company, Philadelphia, for a steamboat plant; two 5-h. p. motors to Armour's packing house, Chicago; two 2, one 3 and one 5 h. p. motor to Farrand & Votey Organ Company, for use at the World's Fair; one 5-h. p. motor to the Wine Growers' Association, Toledo; one 10-h. p. motor to the Citizens' Street Railway Company's shop, Detroit, and many others to different parts of the country.

The Toledo Electric Street Railway Company has added an electric lighting plant for public lighting, and now has a capacity of 5,000 lights, and 1,000-h. p. Cooper Corliss cross compound engine, 1,000-h. p. engine and Thomson-Houston generator, two 2,500 Westinghouse dynamos and transformers form the equipment, and the company expects soon to enlarge its plant further and this year to bid for the city lighting. It now lights the government buildings and a number of others. The Toledo Electric Company and the Western Electric Light Company each do half the city lighting.

The Turbayne-Tamblyn Electrical Company, of Detroit, Mich., which recently removed to 68 and 70 East Fort street, now has its factory in shape to fill orders promptly for its new arc lamp or incandescent circuits. It has recently shipped to the Milford Electric Light Company, Milford, Mich., 20 of the new arc lamps to be used, 10 in series, with a 500-volt power generator; two arc lamps to E. D. Bement & Son, Lansing, Mich., and quite a number to other localities. In a few days the new alternating arc lamp for incandescent circuits will be ready. The company also has some other electrical specialties under way for the trade.

H. A. Kinney, Detroit, Mich., has opened an office at 626 Hammond Building. Mr. Kinney having considerable experience as a contracting electrical engineer and dealer in electrical specialties will no doubt find Detroit and vicinity a profitable field for his business. He is now the agent for Holman's paradox shades, and has a storage battery system for lighting plants for dwellings, factories and steamboats, also agent for automatic gas engines, and will handle electrical supplies for physicians and dentists. He has recently installed a plant for the Davis Boat and Oar Company, 100 lights fed by dynamo or by an auxiliary storage battery when necessary.

The Libbey Glass Company, of Toledo, O., manufacturers of glass bulbs for incandescent lamps and fine cut glass for table and ornamental purposes, is now manufacturing about 20,000 glass bulbs per day for different incandescent lamp factories. It has one of the most complete factories in the United States for this kind of work, and has erected one of the finest buildings to be seen on the World's Fair Grounds, 200 feet long, 150 feet wide, with a tower 100 feet high. In this building the company will manufacture all kinds of fine glass specialties. It has published a very fine highly-colored picture of this building, and has sent fully 25,000 of them to its customers.

ENGLISH NOTES

(From Our Own Correspondent.)

LONDON March 15, 1893.

British Association in 1894.—*The Times* states that Lord Salisbury has accepted the presidency of the British Association next year, when it will meet at Oxford.

Electric Lighting Fatality.—In November last an employé of the House to House Electric Lighting Company met his death while hauling an insulated "live" cable into a duct in the street after having effected a house joint. The widow of the deceased man brought an action against the company, claiming damages, and alleging negligence on the part of the company in allowing her husband to work on a main charged with 2,000 volts. The jury found that the man had himself in no small degree contributed to his death, inasmuch as he had omitted to wear the rubber gloves served out, but they also held that the company was negligent since it permitted its workmen at times to touch a "live" wire. Verdict was given for the plaintiff, with damages to the extent of £195.

Electric Side Lights for Ships.—The secretary of Lloyds has received from the Board of Trade a copy of a memorandum just issued on the subject of electric side lights for ships. The Board of Trade, having had it represented to it that the employment of glow lamps for side lights affected the tint of the green, has had the subject thoroughly investigated. The conclusion arrived at is that when electric side lights are employed, neither of the Board of Trade standard green slides is dark enough. As compared with an oil lamp, a glow lamp screened by the same green slide results in a very pale green, and when the lamp is slightly overrun the light becomes almost white. It is also found that the glow lamps have the effect of paling the red light, but this effect is not so noticeable as in the case of the green slide.

Municipal Electric Lighting.—As I note that the agitation for the municipalization of the gas, electric lighting and water plants continues to simmer on your side of the Atlantic, a few definite figures with regard to its progress in this country, as far as electric lighting is concerned, may be of interest. There are at present eight municipal electric lighting stations actually at work in the United Kingdom, viz.: Bradford (225,000), Brighton (150,000), Dublin (360,000), Dundee (170,000), Glasgow (750,000), Hull (210,000), St. Pancras (235,000), Taunton (20,000). It will thus be seen that electric lighting has been municipalized by authorities having to deal with a population of over 2,000,000. Of these eight stations six are on the low pressure system. In addition to these, three more will shortly come into operation, viz., those at Manchester, Bristol and Portsmouth, and some half a dozen local authorities are fairly committed to electric lighting schemes. For instance, Ealing, a suburb of London, has decided to spend £30,000. Shoreditch and Lambeth have decided to spend £120,000 between them and Blackburn, a Lancashire manufacturing town, has voted £50,000, and local government board inquiries have been held at Derby and Accrington for the purpose of investigating requests of the local authorities of these towns for borrowing powers to the extent of £30,000 and £22,000, respectively, for electric lighting purposes.

News of the Week.

THE ELECTRIC LIGHT.

Margaretville, N. Y., is asking for electric lights.

St. Johnsville, N.Y.—Z. R. Klark contemplates putting in an electric lighting plant.

Holly, N. Y., has appropriated $1,100 for electric street lighting.

North East, Md.—The Reis Electric Supply Company is seeking the franchise for electric lighting for North East.

Lake Hopatcong, N. J.—The Hotel Breslin here will be refitted at a cost of $33,000 and electric lighting introduced.

Patchogue, Long Island, N. Y.—The electric company has decided to increase its power and put in a new dynamo.

East Providence, R. I.—The American Electrical Works Company has leased the old mill of the Richmond Paper Company and will operate a plant there.

Auburn, N. Y.—Sealed proposals will be received to April 3 for lighting the streets here by gas or electricity for the terms of two and five years respectively.

The Wiston Electric Company, of South Milwaukee, Wis., has secured a franchise for erecting an electric light plant, the probable cost to be about $25,000.

North Attleboro, Mass., will issue bonds to the amount of $50,000, to pay for the construction of an electric lighting plant. Moderator W. H. Pond will give details.

North Attleboro, Mass., has voted to instruct a committee to furnish for the town an electric lighting plant for street and commercial lighting at a cost not to exceed $50,000.

The Electric Railway Company of Savannah, Ga., J. W. McFarland, superintendent, is installing a Brush arc light plant of 200 lamps and a Westinghouse alternating plant of 4,000 lamps.

Fisher, Minn.—A scheme is on foot at Fisher to put in a complete system of water works and an electric light plant. The idea is to raise the necessary money by bonding the village. The power will be furnished by the flourmill.

Delevan, Cattaraugus County, N. Y.—The Delevan Electric Light Company has been organized with a capital of $5,000, to furnish electric street lighting here. W. F. Persons is president, and Manly E. King is secretary-treasurer.

The Redlands Electric Light and Power Company, of Redlands, San Bernardino County, Cal., has issued a prospectus setting forth the plans of the company for the development of electric power for lighting, heating and manufacturing purposes. It is understood that the contract for generators, motors, etc., has been given to the General Electric Company and that the plant is to be running by June 1. The pole line is already up.

THE ELECTRIC RAILWAY.

New Castle, Del.—The bill covering the proposed road to Wilmington has been passed.

Rahway, N. J.—A franchise has been granted to the Rahway Electric Company for an electric railway.

The Newton (Mass.) Street Railway Company will extend its track and increase its capital to $365,000.

Clark's Green, Pa.—Subscription papers are being circulated in the matter of the proposed electric road to Scranton.

The electric railway lines now under construction in Ohio amount to nearly 400 miles in length, for the most part being in the northern section of the State.

Chittenango, N. Y.—The Town Board of Sullivan has granted to Walter J. Roberts a franchise to build a street railroad from Chittenango Station to the White Sulphur Springs Hotel.

Bridgeport, W. Va.—A. R. Lyda has been granted a franchise for an electric street railway on the National pike, two miles to West Bridgeport, and also on the streets of Bridgeport, to be a part of the line to run from Bellaire, O., to Martin's Ferry.

The Mt. Victory (O.) Electric Light, Street and Railway Company, capitalized at $400,000, will, it is stated, absorb the Mt. Vernon Electric Light Company, and immediately commence work on a street railway from Mt. Victory to Gambier, about eight miles distant.

The Cayadutta Electric Railroad Company, which is constructing a road from Gloversville to Fonda, N. Y., has purchased a controlling interest in the horse car line from Gloversville to Johnstown, and within the next 30 days the motive power will be changed to electricity.

The Citizens' Street Railway Company, of Detroit, Mich., has closed a contract with the Westinghouse Electric Manufacturing Company for two new 260-h. p. engines to furnish power to run the additional charge to be placed on the Jefferson avenue line to care for the summer traffic to Belle Isle.

Chicago, Ill.—The Chicago Midland Rapid Transit Company, capital stock $15,000,000, is to construct a railway from a point in the first ward west to the city limits, with branches running north, northwest and south. H. Hurlburt, George M. Eckles, P. James Costello and Royal Wilds, all of Chicago, are interested.

Passaic, N. J.—Articles of incorporation have been filed for a road to be built from here to Bloomfield, Montclair, Verona and Caldwell, a distance of about ten miles. The capital is $200,000. E. N. Frisbie, of Passaic, N. J.; Moses E. Worthen, John Kennell and Geo. B. Waterhouse, also of Passaic, and Fred. Lowe, of Jersey City, N. J., are the incorporators. They will at once build.

Chicago and St. Louis Electric Railroad.—The following telegram dated Chicago, Saturday, appears in the daily papers: "Construction work on the Chicago and St. Louis electric railroad, which has been suspended during the severe weather of the last four months, is to be resumed on an extensive scale during the coming week under the recent contracts with Garvey Brothers and Bagnall Brothers, of St. Louis. These call for the completion of the track within a year, at a cost of $5,500,000. It is stated that a force of engineers and graders is to open the work in 10 different places. The line will be double tracked at first, and later two additional tracks are to be laid. The electrical apparatus consists of multiphase motors, those being the only kind capable of carrying the current over such a distance at an even pressure with economy. The General Electric Company has announced that it is prepared to equip the line with this class of machinery and guarantee it to travel 100 miles an hour with perfect safety. Negotiations with this company are now pending for all the electrical equipment." The Chicago and St. Louis Electric Railroad Company is issuing a very creditable little monthly publication which will be known as the "Journal of the Electric Railroad," in which it gives information for farmers and others along the line of way of its new road relating to the company and the electric railroad it is building.

MISCELLANEOUS NOTES.

The price of private telephones in London is very soon to be reduced from $97.50 a year to $48.75 a year, subject to the condition of a five-years contract.

"The Transmitted Word" is the title of a new book by W. J. Keenan and James Riley. This work treats upon the subject of speaking telephones, and is an interesting, complete and comprehensive description of the work of Prof. Bell.

The telautograph, displacing the telephone to any extent, will reduce by so much the practice of profanity over the wire. No man will fancy seeing his choicest oaths reproduced in tame lightning's cleverest script. But how, then, will a subscriber relieve his feelings when his circuit is cut off before he gets to a period?—*N. Y. World.*

The many friends of Mr. B. F. Hamilton, of the Sawyer-Man company, will regret to learn of his sad bereavement through the death of his father, Mr. E. J. Hamilton, lately in charge of the real estate department of the Equitable Life Insurance Company, which occurred on Easter Sunday. The unusually close and affectionate relations between father and son add to the affliction, in which, however, Mr. Hamilton can feel assured of the sympathy of his innumerable electrical friends.

Industrial and Trade Notes.

The Straight Line Indicator, reducing wheel and planimeter seem to be growing in favor in foreign countries. Hine & Robertson, New York, the manufacturers, are making a shipment of a number to South America.

The Purity Oil Filter Manufacturing Company, Pittsburgh, Pa., has received a third order for its new patent ideal steam oil refiner from the Pennsylvania Railroad Company, and a very flattering testimonial from A. L. Ide & Son, manufacturers of Ide and Ideal engines.

Cured by Electricity.—H. P. Wenzel, M. D., West Water street, Milwaukee, Wis., writes to the Jerome Kidder Manufacturing Company, 820 Broadway, New York: "I have your Faradic battery since 1875, and can ascribe several recoveries of narcotic poisoning to its use."

T. L. Brooks, Port Byron, N. Y., is much pleased with the success which his Columbian electro-medicatorium is meeting with. This is a device for self-administering mild, pleasant and healthful shocks. It is adjusted so that any desired current can be received, and it is claimed to be especially useful for curing nervous and muscular diseases.

The Jenney Electric Motor Company, Indianapolis, Ind., has received a large number of letters from prominent firms and companies testifying to the excellence of its machines, and the satisfaction they have given. Among others may be mentioned a communication from Mast, Crowell & Kirkpatrick, Springfield, O; the D. S. McDonald Company, Boston, Mass., and Kingan & Co.

The National Telephone Manufacturing Company has just completed another service for the Lehigh Valley Coal Company in its Maltby mine at Wilkes-Barre, Pa. This line is 5,500 feet underground with three stations. Bell telephones were displaced. The Lehigh company's officials are well pleased with the service and have placed an additional order for a three-station line of 2,000 feet in another mine.

T. W. Ness, 749 Craig street, Montreal, manufacturer of main line and warehouse telephones, switchboards, annunciators, etc., has furnished a large number of exchanges with his telephone instruments, which have always given satisfaction. He is sending an exhibit to the World's Fair, part of which was on view recently in the *Herald* Building, Montreal, when that building was totally destroyed by fire. Mr. Ness' exhibit, however, was saved and will be shown at the Fair.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for a new bridge at Norwich, Conn., to span the tracks of the Norwich & Worcester branch of the New York & New England Railroad over the Shetucket River. The bridge will consist of one span of 145 feet, with a roadway 24 feet wide in the clear, and two sidewalks each 5 feet wide in the clear. The roadway and sidewalks will both be covered with steel buckle plates and concrete.

The Viaduct Manufacturing Company, Baltimore, Md., has been for a long time engaged in the manufacture of magneto bells, and has met with great success in this line. It is constantly making improvements, and endeavors to produce the most reliable apparatus possible. The installation of this company at the relay house of the Baltimore & Ohio Railroad, Baltimore, possesses considerable interest; no steam power is used, the Patapsco River furnishing the necessary power.

Jarvis B. Edson, 85 Liberty street, New York City, sole proprietor and manufacturer of the well known pressure recording gauges bearing his name, has recently filled an order for one of the improved pressure recorders of the Allegheny Light Company, of Pittsburgh, Pa. The Edson pressure recorder is known the world over, and during the past 20 years has established a reputation for accuracy and reliability which has rendered this instrument essential to every well equipped modern power plant.

The American Electro-Enamellite Company, of Newark, N. J., will soon put upon the market a full line of electrical heating and cooking appliances, tubes for rheostat work and the like. Mr. George Cutter, president of the company, has been in Newark for the last three weeks, and under his immediate personal supervision the World's Fair exhibit of the company is being prepared. A large number of orders for tubes, etc., are already in hand, which will be filled as soon as the factory can catch up with the work.

J. Bradford Sargent, 620 Atlantic avenue, Boston, Mass., New England representative of the Sterling water tube safety boilers reports the following recent sales made within the short space of 10 days: Union Railway Company, New York City, 1,500 h. p.; Lindell Avenue Street Railway Company, St. Louis, 2,700 h. p.; General Electric Company, Cleveland, O., 400 h. p.; Crown Brewery, Philadelphia, 400 h. p.; Hyde Park Electric Company, Chicago (third order), 700 h. p.; Siemens & Halske Co., Chicago, 500 h. p., besides many smaller sales.

The Falls Rivet and Machine Company, Cuyahoga Falls, O., has recently equipped a large number of electric light and power plants with its ring oiling bearings and line shifting and clutch pulleys. One order was for the General Electric Company, for electric plants at Syracuse, N. Y.; Louisville, Ky., and Toledo, O. This company has sent out a little folder describing its apparatus, and giving a partial list of the plants where it is installed, which includes a large number of the most prominent lighting and power plants in the country.

Brown's Keystone Cement, manufactured by Brown's Keystone Cement Company, Bullitt Building, Philadelphia, for which Mr. B. Frank Johnson, 44 Broad street, New York City, is general agent for New York, has met with merited success, as attested by the numerous testimonials in its favor which have been received from every section of the country. Used on steam boilers, steam pipes or hot air pipes, it prevents radiation and consequently economizes fuel, while it keeps cold water pipes from freezing and iron columns from cracking or twisting in case of fire.

W. A. Vail has on exhibition at his office, 136 Liberty street, New York City, a new wood pulp battery jar, which is intended to take the place of hard rubber for storage and primary battery cells. This insulating material is called Ajax fibre. Severe tests have shown it to be acid proof for electrical purposes, and a very excellent insulator. These properties have been lacking hitherto in battery jars of wood pulp, but it is claimed that they are possessed in a high degree by the Ajax jars. In the description of the Swinging Ball Lightning Arrester in the last issue of THE ELECTRICAL WORLD the name of the street and the address were accidentally omitted and instead of 136 street it should have read 136 Liberty street.

The Stearns Manufacturing Company, Erie, Pa., has recently sold a large number of its small engines and boilers, while of the larger sizes one 200 h. p. vertical cross compound engine has been shipped to the Japan electric light plant; one 500 h. p. tandem compound engine and five 115 h. p. boilers to the Citizens' Electric Light and Power Company, Rochester, N. Y. (this engine is a duplicate of the one the company will exhibit at the World's Fair); one 350 h. p. engine and boilers to the Electric Light Company, Manchester, N. H.; one 75 h. p. engine is being built for the Empire Theatre, Philadelphia, Pa., and will be directly connected to the dynamo. The company has a large number of orders on hand.

The Delaware Hard Fibre Company, of Wilmington, Del., has recently made some interesting tests in regard to the tensile and crushing strength of their hard fibre which illustrates some of the remarkable properties of that material. A sample disc 1½ inches in diameter and 1 inch thick cut from a sheet of fibre was found to crush under a total pressure of 40 tons, which would correspond with a pressure of about 23 tons per square inch. A sample of their round rod tested by the Edge Moor Bridge Works broke under a tensile strength of 8,600 pounds per square inch, which closely corresponds with results obtained at the Royal Technical and Mechanical Testing Department of the German Army, Berlin. Three samples which were tested here gave results varying from 8,000 to 9,000 pounds per square inch. Such results as these can only be obtained from a fibre free from clay or other adulterations.

The Eureka Oil Purifier Manufacturing Company, of Philadelphia, is meeting with great success with its new filter, as

is evidenced by the following orders recently received: Germantown Spinning Company, Germantown, Philadelphia; Germantown Electric Light Company, Germantown, Philadelphia; Gloucester City Electric Light Company, Gloucester City, N. J.; O. Zinn & Co., Oil Merchants, Philadelphia; Pennsylvania Institute Deaf and Dumb, Mount Airy, Pa.; Scott & Williams, Philadelphia; Bloomsburg Electric Light Company, Bloomsburg, Pa.; Milton Electric Light Company, Milton, Pa.; the Hudson Electric Light Company, Hoboken, N. J.; The Newark Electric Light and Power Company, Newark, N. J.; Masonic Temple, Camden, N. J.; The Columbia Electric Light Plant, Columbia, Pa.; C. A. Burt Co., New Orleans, La.; the F. Lauer Brewing Company, Reading, Pa.; the Willimantic Linen Company, Willimantic, Conn. According to the great number of testimonials, of which the General Electric Company is one, these purifiers must be of a very superior quality. This company has only been in existence a little over six months and has reason to congratulate itself on its great success thus far.

The National water tube boiler plant now in use at the station of the United States Electric Lighting Company, Washington, D. C., has many important features of advantage. There are six boilers, aggregating 2,500 h. p. nominal, with an effective capacity largely above that amount. The boilers are of the well known National water tube type, made at New Brunswick, N. J., and were specially designed to give a large amount of power within a limited space. This is accomplished by massing in each boiler a large amount of heating surface, while retaining all necessary advantages of access for examining and cleaning both externally and internally. The construction of the National boiler permits this adaptation to local surroundings, and where necessary the space required for a large plant may be greatly reduced. Each of the boilers of this plant has three storage drums, giving ample storage capacity, even where the demand for steam is sudden and heavy. Each boiler is set independently and has independent steam and water connections, in order that one or more may be shut down for cleaning and examination without disturbing the others. Each boiler has three furnace openings, allowing one-third of the grate to be cleaned or replenished without disturbing the balance. Ample cleaning doors are provided in the sides of the boiler walls, through which all parts requiring cleaning may be readily reached, and the large door provided at the rear of each boiler setting allows free entrance to the rear of the boiler and flue. The ordinary working pressure is 140 pounds to the square inch but the limit of safety is largely above that pressure, and the working pressure may be increased if desired. The engine plant of the United States Electric Lighting Company comprises compound engines of the most modern type; and with the economy reached by the use of the National boilers and compound engines the best results in modern steam engineering are reached.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filters for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

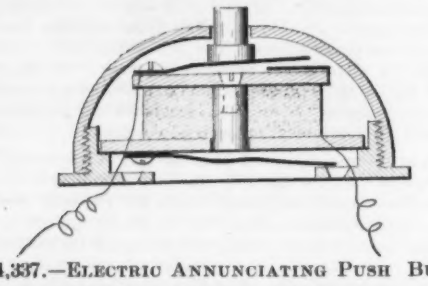
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED MARCH 28, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

494,146. Magnetic Lock; Alcuin E. Kintner, Painesville, O. Application filed April 4, 1892. A magnetic lock with a knob spindle passing through a collar having an extending arm provided with a pin at its end, engaging and operating in combination with a slotted slide, a dog pivoted to the face plate through the slot, and a latch and pivoted counterweight.

494,149. Process of Manufacturing Filaments for Incandescent Lamps; Alex. de Lodyguine, Paris, France. Application filed Sept. 14, 1888. A process of making carbon filaments for electric lamps by dehydrating and decomposing the incandescents or filaments by the action of a chemical agent; then subjecting them to a high temperature with the exclusion of oxygen; then expelling the occluded gases from the incandescents and coking them by subjecting them to a high temperature by the passage of an electric current, and finally giving them the required resistance by the deposition of a carbon.



No. 494,337.—Electric Annunciating Push Button.

494,150. Process of Manufacturing Filaments for Incandescent Lamps; Alex. de Lodyguine, Paris, France. Application filed Sept. 14, 1888. This process consists in heating carbonized organic filaments by currents of electricity in vacuo until they are changed into hard carbon and the permanent or cold resistance is reduced to approximately the original carbonized filaments.

494,151. Filament for Incandescent Lamps; Alex. de Lodyguine, Paris, France. Application filed Sept. 14, 1888. An incandescent filament for electric lamps composed of a core or body of electrically coked organic carbon and an external cell of deposited carbon.

494,185. Printing-Telegraph; John E. Wright, New York. Application filed Nov. 16, 1892. In a column printing telegraph instrument, the combination with a type-wheel and carriage for same movable transversely for printing lines of characters, an extension rod and universal joints between the two members of the same and the type-wheel and escapement respectively.

494,186. Lightning-Arrester; Alexander Wurts, Pittsburgh, Pa. Application filed Jan. 14, 1892. In a device for removing the static charge from a conductor, the combination with a single series of contact plates and a condenser for each plate of the series, each condenser having one side connected to its proper contact plate and having its other side grounded, of two arms, adapted to come into contact with this series of contact plates in order, one of the arms being connected to the conductor to be discharged and the other being grounded.

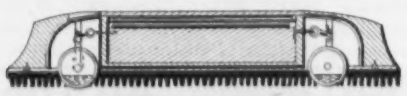
494,199. Pyro-electric Battery; Thurston Gordon Hall Chicago, Ill. Application filed March 8, 1892. A pyro-electric battery constructed of elements of opposite electric polarity, separated from each other by porous insulating material and arranged so that heated gaseous material can be forced through the series of passages formed by the interstices obtaining in the pyro-electric pile constituting the battery.

494,225. Electrical Meter; Gustaf Rennerfelt, Buffalo, N. Y. Application filed April 1, 1892. The combination with the driving cones and the movable core of the electromagnet, of the yoke connected with the core and movable thereby along and between the cones lengthwise, the bar movable transversely in the slideways of the yoke, the transmitting friction wheel mounted on the bar in the plane of the axes of the rolls and springs opposing the pull of the electromagnet.

494,239. Electrical Excitation of Vacuum Tubes; Harry T. Barnett, London, Eng. Application filed Feb 5, 1892. In a system of electrically illuminating vacuum tubes, the combination of glass plate condensing plates secured to the same side of the plate, a vacuum tube connected at each end with a condensing plate, condensing plates arranged opposite the plates and leads connecting the plates with an induction coil.

494,278. Electric Bell; F. W. Manger and O. T. Hubbell Brooklyn, N. Y. Application filed June 8, 1892. An electromagnet having its core formed with an enlarged head, combined with a bracket piece confined between the head and the spool of the magnet, and serving as a support for the armature.

494,279. Circuit of Electric Signaling; Morris Martin, Malden, Mass. Application filed July 14, 1890. This consists of a main metallic line connecting the receiving and transmitting stations and having a battery included therein; a receiving instrument in a branch of the main line, and normally shunted thereby while the main line is closed and intact; and a ground branch and receiving instrument therein at the receiving station, connected with an intermediate portion of the battery, and a transmitting instrument comprising a break wheel or a movable signaling surface, and contacts so operating therewith connected with the portions of the main line extending to the opposite terminals of the main battery and a contact connected with the ground.



No. 494,359.—Electric Brush.

494,286. Apparatus for Protecting Buildings from Lightning; Jonathan B. L. Bartlett, Boston, Mass. Application filed Oct. 31, 1892. A system or apparatus for protecting buildings from damage by lightning, comprising a wire or wires in an electrical circuit strung externally on a building and an electric bell or alarm arranged to be included in the circuit by the operation of a switch.

494,291. Electric Heating Apparatus; Mark W. Dewey, Syracuse, N. Y. Application filed March 24, 1892. In an electric heater, a plate, saddles of insulating material on two edges of the plate, and a resistance conductor wound around the plate alternately across opposite planes thereof, but not in contact therewith, and a perforated case.

494,295. Induction System of Electrical Heating; S. B. Jenkins, Boston, Mass. Application filed May 28, 1892. The method of generating heat by electricity and applying the same to a heating system for various points or apartments, consisting in sending a continuous current and an intermittent current in opposite directions with respect to the length of the cores on which they are wound, the interruption of the latter current generating a reverse induced current and producing heat thereby known as the heat of hysteresis while the continuous current first mentioned prevents sparking at such interruptions.

494,301. Electrically Heated Radiator; Willis Mitchell Malden, Mass. Application filed June 8, 1892. A radiator provided with externally extending cores, in combination with electrical heaters applied to the cores, each heater consisting of successive helicoidal coils of wires in electric circuit and interposed cylindrical partitions.

494,337. Electric Annunciating Push-Button; John King, Chicago, Ill. Application filed June 24, 1892. This consists of a base piece adapted to support an electromagnet, an electromagnet supported thereby in the line circuit, spring terminals mounted on the magnet, a button for closing the terminals, and an armature for the magnet located within the base piece and adapted to produce a resonating sound when caused to vibrate by a make and break device in the same circuit. (See illustration.)

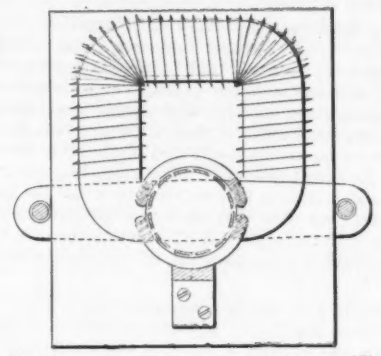
494,344. Controlling Device for Electric Cars; J. H. Neal, Boston, Mass. Application filed Dec. 30 1891. A tubular shaft, a wheel thereon to rotate it, a shaft arranged within this tubular shaft and a crank to rotate the inner shaft, the crank being adjacent to and above the wheel and of a lesser radius, combined with a brake mechanism, a current regulator, intermediate connections between the brake mechanism and current regulator, the tubular shaft, circuit reverser and an intermediate connection between it and the inner shaft rotation of the wheel in either direction positively controlling the current and brake mechanism equally at all times, rotation of the crank reversing the current.

494,345. Electric Signaling Apparatus; Frederick Pearce, New York. Application filed Nov. 2, 1892. The combination with the electric conductors of a fixed stem, signaling mechanism supported by the fixed stem and connected with the conductors, a watertight case surrounding the fixed stem and the signaling mechanism, the case being flexibly connected and movable, and a train of gearing receiving its motion from the case and actuating the electric signaling device.

494,348. Electric Lamp Support; Charles E. Richardson, Springfield, Vt. Application filed Nov. 16, 1892. A supporting device comprising in its construction an extensible arm composed of two members fitted to slide one upon the other and provided with coinciding grooves in their inner sides for the reception of a flexible conductor; external elastic clips which connect the two members together and hold them by friction at any desired longitudinal adjustment and a universal joint device connected to the inner end of one of the members.

494,359. Electric Brush; Robert E. Williams, Hot Springs Ark. Application filed Nov. 29, 1892. An electric brush having yielding rollers comprising the electrodes of the brush. (See illustration.)

494,395. Electric Bolt-Operating Mechanism for Safes; Emory Stockwell and Herbert C. Stockwell, Stamford, Conn. Application filed July 11, 1892. A bolt-operating mechanism for safes, comprising suitable bolt-work which is cast and retracted by an electric motor suitably geared thereto, an automatically disengaging clutch for throwing the bolt-work out of gear when it is cast; and a time lock for throwing the motor into gear at the proper time.

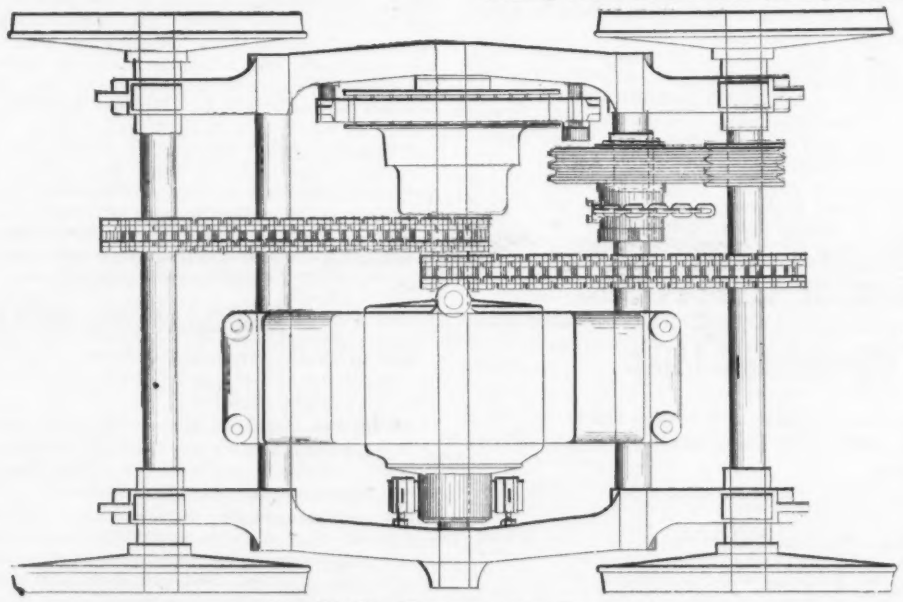


No. 494,513.—Alternating Current Meter.

494,499. Globe Holder for Electric Arc Lamps; Wm. A. Turbayne, Detroit, Mich. Application filed July 1, 1892. The combination of a tail tube, a flange on this tube, a sleeve fitted on this tube, and enlargement on the sleeve, a recessed annular flange on this enlargement, and spring hooks on the sleeve engaging the flange on the tail tube.

494,505. Car Brake; M. E. Campany, Hamilton, Mich. Application filed April 5, 1892. In a car brake, the combination, with the axle of the car, of a friction clutch mounted thereon, one of the pieces of this clutch being movable longitudinally on the axle and provided with a drum, a chain from the drum to the brake lever, a lever pivotally secured to the frame of the car, one end of which lever engages with the movable portion of the clutch, an electrical motor secured to the car provided with a projecting shaft, and a chain secured to the opposite end of the pivoted lever and to the projecting end of the shaft, and adapted to be wound thereon, whereby the lever is operated and the clutch is thrown into engagement and the brakes are set.

494,513. Alternating Current Meter; William Stanley, Jr., Pittsfield, Mass. Application filed Aug. 11, 1892. The combination, with a rotary spindle or shaft, a registering device operated thereby, and conductors carried by the spindle and forming closed circuits with paths parallel to the axis of the spindle, of independent field coils or circuits of different self-induction acting on different portions of the conductors, and having their magnetic axes at an angle. (See illustration.)



No. 494,479.—Electric Car Truck.

494,520. Electrical Instrument for Medical Purposes; H. Y. Boyd, Wichita, Kan. Application filed Dec. 15, 1892. An electrical instrument for medical purposes composed of cylinders of negative and positive elements separated by an electrical non-conducting cylinder.

494,525. Block Signal System for Railways; Eugene Fontaine, Detroit, Mich. Application filed July 11, 1892. The combination, with a semaphore, of a connecting rod composed of an independently movable upper section provided with a spring to move it into one position and hold it there, and of an independently movable lower section provided with a spring and a coupling device, whereby when two sections are coupled together the lower section is adapted to move and hold the semaphore in its other position.

494,531. Electric Lamp Vibrator-Regulator; Daniel McFarlan Moore, New York. Application filed Nov. 23, 1893. An electric lamp regulator consisting of the combination, with the bulb and filament, of an incandescent electric lamp, an armature controlled current vibrator within the bulb and in circuit with the filament, a magnet outside of the bulb and within inductive action of the armature, and means for varying the relative distance between the armature and the magnet.

891,385. Telephone and Signaling Circuit; Frank A. Pickernell, Newark, N. J. Application filed Dec. 15, 1892. A circuit extending between two switchboards and terminating at one of them in an extensible cord and plug; a normally open associated signaling circuit including an electrical generator; an automatic circuit closer therefor actuated by the operation of the plug; two annunciators in the signaling circuit, the first responsive to the operation of the circuit closer directly, and the second to the operation of the circuit closer only when the first is shunted.

494,446. Lock; Frank Simons, St. Louis, Mo. Application filed Oct. 22, 1892. An improved lock having a locking mechanism comprising a central cylindrical shaped portion provided with projecting annular rims, separated by annular grooves, curvilinear depressions in alignment in the periphery of each of these plates and extending inwardly to the cylindrical central portion, and a smaller curvilinear recess in each of the plates adjoining the larger recesses.

494,477. Electric Railway; John C. Henry, New York. Application filed Aug. 19, 1890. The combination of stationary contact pins in the roadway and two contact shoes carried by the car and adapted to grasp the contact pins between them as they move along.

494,479. Electric Car Truck; John C. Henry, New York Application filed Jan. 2, 1892. The combination of a car truck an electric motor thereon, and differential speed reducing gear the car truck having a projection whereon a member of the gear rotates. (See illustration.)

494,489. Electric Signal, Switch Moving and Interlocking Mechanism; Joseph Ramsey, Jr., and Edward W. Harden, Cincinnati, O. Application filed Aug. 13, 1892. The combination of a railway switch with a switch motor and its circuit, a signal indicator and magnet at the tower in the circuit, with an armature for making and breaking the switch motor circuit, whereby the switch circuit is broken when the signals are at safety.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.